The FOUNDRY

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Were YOU There in '96?

PHILADELPHIA, the birthplace of the American Foundrymen's association again will welcome that organization as its guest during the week of May 14, 1928. This marks the thirty-second annual convention of the association and the fourth gathering to be held in that city.

The vision of that band of 346 foundrymen whose names appear upon the registration list of the first convention is fulfilled by the growth and service of the American Foundrymen's association. How many of this number still are active in life's occupations? How many still are interested in the foundry industry with which they were identified in some way in 1896? How many again will answer the call of Philadephia on May 14-19, 1928?

DELEGATE'S BADGE OF THE FIRST CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION. THE RIBBON CARRIED PHILADELPHIA'S COLORS, BLUE AND YELLOW

Did you wear this badge in '96?

Can you give the present place of residence of others who did?

Are you going to Philadelphia May 14, 1928?

Will you write to The Editor, THE FOUNDRY, 1213 W. Third street, Cleveland, or C. E. Hoyt, Secretary, American Foundrymen's association, 140 S. Dearborn street, Chicago, in answer to these questions?

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What Beginners

WHEN foundrymen are old and gray and their days are almost told,
The young beginners of today will have to pour the mold.
When we are on the pension list and think of days of yore
'Tis the green boy of the present day who will have to make the core.

While we're watching a new man taking off a heat
We pensioned-off old timers will get our biggest treat;
And when it comes to mixtures of scrap and coke and pig,
He'll know how to handle heats, although the job is big.

And when we good old timers are called upon to go,
We'll leave our jobs without regret because we're sure, you know,
The stripling we have trained so well in all the foundry features
Will fill the bill, and better still, do credit to his teachers.

A. D. HESS, Apprentice Supervisor.
Whiting Corp., Harvey, Ill.

LATE in the afternoon of an exceedingly warm day in July, not so many years ago, I walked into the yard of a large steel foundry with a package of lunch and a pair of overalls under my arm. The overalls were old ones, because I knew that for a young chap to begin work on a new job was awkward enough in any case without the added disadvantage of crinkly, new overalls. The night superintendent and the training director of the corporation were waiting for me, where a railroad track went into the shop through a huge door. The training director I knew well, as I had been working under him for several years. I was particularly interested to see what kind of a man the night superintendent might be because arrangements had been made whereby I was to work under him.

The night superintendent surprised me favorably. I expected to find a rough fellow with little to recommend him except a knowledge of his business and the ability to get work out of a crowd of men. Instead, I met a man less than 30 years old with much obvious refinement and a command of the English language which one hardly would expect to find except, perhaps, in the teaching profession. He was slender and of medium height and wore horned-rimmed spectacles. The most remarkable feature of his attire was an utterly shapeless and colorless old felt hat. As I approached, he took a few last, eager drags from his cigaret which was almost consumed and which he threw away before speaking. Such was the man who was to exert a strong influence over me for many months to come.

Six weeks before I had completed a course in engineering and now I was to enter upon my professional career. Acting upon the advice of a number of persons whose opinion I respected and whom I had consulted in the matter, I had selected the foundry business as the field in which to try my fortune. It was not the first time I had been in a foundry as I had pursued a co-operative course in engineering and had spent many months as a student, as core maker, molder's helper and in closing core jobs and even molding, in addition to working in machine shops and other departments.

Attractions Glittered

I cannot say that I was particularly attracted by foundry work, although molten metal with its countless whims and unexpected performances, always had fascinated me. My principal reason for casting my lot with the foundry was because I thought I would have less competition in this line of work from other engineering graduates. The average young engineer avoids the foundry

rs Think About

By C. J. Freund

as much as possible as a student and flees precipitously from the casting shop after graduation. I felt that in this work I would have little to fear from other engineers as far as promotion was concerned. The training director thought I had a good idea and recommended that I begin my foundry experience by a period of training with the night gang and under the supervision of the night superintendent.

The training director introduced me to my new boss who asked a few questions and then told me what I was to do. And instantly I had the first thrill of my new career.

"I think we shall put you on the chains with the 50-ton crane in this bay," he told me.

"All right," I answered, but the expression in my face and possibly flat tone in my voice must have given me away for he looked at me quite sharply and asked:

"What is the matter?"

I answered, "Nothing"; although I was much disappointed.

Starting Low to Rise

The fact was that I thought that I would be given some more dignified work to do in view of the fact that I had completed a course in engineering and had done some little foundry work. As long as three years before that I had been molding in a foundry as a student apprentice and one day, when a chainman was absent the foreman had asked me, apologetically, if I would work on the chains and I did work on them for several days, but I had never since descended so low. Here was I with three more years of shop experience and a degree in engineering, back at the same work which I had considered beneath me three years ago. I did not yet realize that my work on the chains was part of a training program which carefully had been prepared.

I was shown the place to leave my coat and my lunch and then the superintendent blew a short blast on the whistle which he took from his pocket and made some motions with his arms whereupon a tall, dark young man with a blue handkerchief about his neck approached with long strides and the superintendent pointed to me with his forefinger by way of introduction.

He of the blue handkerchief, who turned out to be the foreman of the 80-foot bay, or big floor, motioned to me to come and I walked rapidly with him to where a big crane was working with only one man on the chains. The foreman called to this man, pointed to me and then struck his extended forefingers together in a gesture which I found later meant that we two were to work together. Then he turned to me.

"That fellow will show you what to do. Watch him closely; he knows his business. Never let the craneman hoist until your hitch is secure. It you are not sure, ask your partner. Don't forget that a crane load swings. Stand away when it is lifted. Never stand under a passing load and never hold your hands on the chains when a lift is made. You always have time to walk; never ride the chains nor a load. Remember what I have told you. I'll tell you more later."

Being told all this increased my chagrin for I had heard it all a countless number of times during the past four years. However, this foreman certainly did not know this and I appreciated his efforts to give me a good start and thanked him, whereupon he grunted stolidly and walked down the shop whistling and signaling with hands and arms to the men who were scattered about the floor upon various tasks. This foreman's name was just plain Brown and he gave me many a helping hand during the months

of interesting work that followed.

My first impression of my partner was mostly black mustache, black eyes and a limited English vocabulary. The moment the foreman turned his back he looked at the craneman and pointed at me derisively with his arm fully extended as much as to say, "Look what they found to work with us." Thereupon both laughed uproariously.

Knew He Knew—Nothing

The work went much better than I anticipated. I soon found that I knew nothing whatever about foundry night work. I had understood, in a general way, that the foundry night force dried molds and cores, prepared sand, moved heavy jobs and poured the heavy castings, but the manner of doing all this was unknown to me. The entire shop appeared to be a confused mass of cranes, grab buckets, huge boxes of sand, molds and flasks all rushing wildly hither and thither. I say that the work went better than I anticipated because my partner gave me many more pointers than his first welcome led me to expect.

Our first task, after removing a few odd flasks which were lying about the floor, was to load the great oven trucks with molds which were to be dried during the night. Although the job on the chains was not so much to my liking it took me but a few moments to learn that I knew little about making the hitches. The proper lifting and moving of mighty flasks, 14 and 16 feet in diameter, was something altogether different from the chaining which I had done as a student in a small foundry.

The trucks hardly were loaded and pushed into the ovens when a great red glare on the other side of the shop indicated that they were tapping one of the open hearth furnaces. Thereupon my partner motioned to me to follow him and went to a locker from which he took a long aluminum rod and a torch made of a bundle of waste tied on the end of a long steel rod. He dipped the waste into a bucket of kerosene and handed it to me. "For gas," he explained as he took the aluminum rod and hurried to where the crane was waiting to hook onto the bail for lifting the ladle.

By this time the 25-ton ladle had come into our bay on a ladle car and the foreman watched me carefully as I hooked onto my side of the ladle although how to do it was obvious. In the meantime a motley crew had assembled about the ladle: the night superintendent with a pocketful of salted peanuts with which he fed himself at intervals, the foreman with a pair of goggles and his blue handkerchief wrapped tightly about his neck, the ladleman with hammer, hook and test ingot mold, men with bars, men with shovels, men with sledge hammers, a veritable retinue.

The superintendent pointed to a huge mold in a 14 or 16-foot flask, the ladle was spotted over the cup, the foreman seized the long lever, the ladle man loosened the gear and with a sudden burst of light the stream of liquid steel rushed from the nozzle in the bottom of the ladle and into the cup while a tremendous, hollow sound of gurgling and rumbling rose from the depths of the big mold. The superintendent took my partner's aluminum rod and held it in the stream for a few seconds while my partner took my torch, lighted it at the stream and set fire to the gas which began to stream from the mold at every crevice. Thereupon he returned the torch as much as to say, "Go thou and do likewise," and resumed his aluminum rod. It all was intensely interesting to me because it was so different from the iron foundry practice of having small ladles all over the floor with which each molder and his helper poured off the pieces which they had made.

All Through the Night

The greater part of the night was spent in bringing sand from the shakeout floor to a long concrete runway where it was sprayed with water and mixed by a huge, tractor like contrivance with revolving blades which roared slowly along over the pile like a tank across a dusty battlefield. Great volumes of sand were dumped into pits and from these were elevated into overhead storage bins for the facing mills. Several heats came out during the night and when daylight broke upon the east end of the shop, the molds which had been poured during the night were moved to the shakeout floor and much consulting of watches on all sides indicated that the night's work was nearly done. I went home tired and somewhat puzzled, not so much by the night's work as by the part which I had played in it.

Toward morning of the third or fourth night I was sitting on the top of a huge pile of refuse in the east end of the foundry which was being replenished by visits from the crane and grab bucket at regular intervals of 4 minutes and 20 seconds, which period of time I determined by my watch for lack of something better to do while I waited for the crane. Another crane with grab buckets was loading the refuse into big trucks which removed it. My task was to trip the bucket and then to rush around in circles on top of the pile trying to escape the resulting cloud of dust. A subsequent glance into a looking glass demonstrated the success of my efforts, or lack of it.

Future Looked Futile

As I sat waiting for the bucket I thought over my present situation. Several thousand dollars had been invested in my education and my hard work for many years in high school and college had brought me to the top of a pile of dirt. I derived a certain unholy glee from assuring myself that in less than an hour I could teach my eight-year old nephew to trip the bucket as well as I could do it; and he probably would enjoy the dust more than I did. I had one of the smallest jobs in the foundry, although I had probably spent more time preparing for my life work than anyone in the shop. I was much afraid that some of my friends might learn about my position and consider me a failure.

While I was turning these thoughts over in my mind, the night superintendent clambered up the side of the pile and to my great surprise sat down beside me and began to talk. For some time he discussed the work in general, the relation of night work to foundry operation, the ideals of good workmanship which he had set up for himself and his men and other subjects of like character. He declared himself willing at all times to assist me in learning the work and to answer any questions which might suggest themselves. I asked him a number of things which already had perplexed me and his manner was so pleasant that I ventured to bring up the subject uppermost in my mind. I admitted that there was much about hitching that I did not know but suggested to him as tactfully as I could that this would be the case with any job whatever and that I thought that my preparation and education should entitle me to a better class of work. His answer was so simple and so logical that not only was I contented with what I was doing, but felt ashamed that I had not thought of it myself. Possibly he thought that I had reasoned it out. In any case, I should have.

"That is all easily explained," he said, "you are here not only to get a good general knowledge of the work we are doing but also, later on, to get some experience in handling men. If you appear to be qualified,

we shall give you more responsibility as time passes. If you are promoted you will need the co-operation of the men with whom you are working. If you should become a straw boss you would not be a success unless the men under you recognized your right to hold the position. Now, these men recognize only one right to promotion and that is demonstrated ability in every position leading up to the promotion. If I should make you an assistant to the foreman on this floor, give you an opportunity to study the work through observation and then try to give you some little authority, the men would resent your position and anything you told them. Moreover, I do not know myself that you ever could hold a boss's job.

"On the other hand, by starting you in on the meanest job in the shop you have an opportunity to demonstrate your ability at this work and every other kind of work which may be given you. With your education and the application to business which is expected of you, you should have no difficulty not only in mastering a chainman's job within a few months, but even in attaining a proficiency in the work superior to that of any other chainman. If you then are given a better job every man in the shop will concede the justice of the promotion and will co-operate with you accordingly. And so it will be with every successive job. You have been assigned to me for instruction. I take a certain pride in doing my work as well I can and I shall bend every effort to make your training as thorough as it can possibly be."

Opens a Vista

That little speech was a revelation to me. Just as I had been disappointed by my assignment on the first night, so was I now delighted with this man's attitude toward me and more especially, with the thought which he had devoted to my well being. The entire situation now presented itself in an entirely new light and I went home that morning in a state of mind that bordered on elation.

Several months later, when I had acquired a certain proficiency on the chains and felt confident of my ability, the superintendent came to me one evening and told me that he was going to put me to work in the yard where I was to become a member of the gang and get some pointers from the yard boss. We walked out together over tracks and switches, between huge piles of pig iron and scrap of various kinds until we came to a place where a half dozen men were struggling with a crane and a heavy piece of broken steel which they were trying to lift into a charging box which was set on a small car. Similar cars with charging boxes stood here and there in the yard, some loaded and others empty. I was introduced to the yard boss, a short, energetic, rather talkative chap, while the other men stared with much interest at the newcomer or talked to each other about him in a foreign language.

Food For Furnaces

The superinendent and the foreman spoke a few words together in a low voice and work was resumed as the superintendent went back into the foundry. I knew that the task of the yard gang was to bring the necessary raw material to the charging floor of the open-hearth furnaces, but I never had given this work any further thought. An hour or two convinced me that the work was somewhat complicated. It was the duty of the yard foreman to study the specifications of the various heats and bring up the right class of metal and the right weight. The metal had to be loaded by the crane with a magnet or hook chain, weighed and, by means of the many turntables and switches, so placed on different tracks that the material required for each heat would be available instantly and could be pulled up on the inclined railway to the furnace platform whenever the melters should call for it.

It did not take me long to comprehend the foreman's method of planning his work except that I had great difficulty in figuring out just how the carloads of different kinds of material were switched about so that they always were first in order to go up to the furnaces at the proper time. A map of the yard, showing tracks, switches and turntables would have been of great assistance, but there was none about and upon inquiring I found that none was available.

On the third or fourth night in the yard the foreman gave me several lessons in the use of the switches and controllers by which the cars of loaded charging boxes are pulled up to the furnace platform. Within a week, also, I had been up in the cab with the crane operator and had learned how utterly demoralizing it is to attempt to use a number of controllers and a brake simultaneously.

During all these days the foreman continued to encourage me and to make himself agreeable. On the other hand, nothing that I could do would induce the men to discard their attitude of aloofness. The lack of a common language should not have stood in the way, there was something else wrong. The crane operator took a position about midway between these two. He spoke English after a fashion and, like the foreman, was able to make himself understood in two or three languages of Southeastern Europe which the men understood. While the foreman was around, he was agreeable enough, but otherwise he sided with the men.

One night, after I had been in the yard about a week, we were waiting for the whistle to blow and the foreman had not yet put in his appearance. Usually he was the first one there and I wondered why he should come later than usual. Suddenly, the superintendent came walking rapidly out of the foundry and directly at me and a horrible suspicion came into my mind. Everyone is eager for new and increased responsibilities, but when they are unexpectedly thrust upon you before you are prepared for them it is altogether a different matter. My fears were confirmed when the superintendent told me that Charlie (that was the foreman's name) was ill and had telephoned that he could not work that night.

"I wanted you to understudy him because he is expected to leave for a better position within several weeks. However, I was not prepared for this. I know that you are not yet ready to handle the situation but I am shorthanded tonight and there is no one I can send out here. You will have to make the best of it. I will come out occasionally to give you a hand if you need it. You are the only one out here who can use the scales and make out the charging reports and I shall have to leave you in charge. Let's go up to the platform to see what is wanted for the second heat; the first heat is already up there."

Unsought Honors

We went up to the platform and examined the bulletin board and I wrote into my notebook the proportion of pig iron and various kinds of scrap which was required for the heats of the night. Then I went back into the yard alone and I am certain that at the moment I was the most uncomfortable person in the world.

Here I was in charge of a job I only partly understood and which was to be done with men whom I did not understand, who never had given any sign of friendship and who probably were hostile. They were all

(*Concluded on Page 72*)

When SHOULD STEEL CASTINGS *Be Welded?*

BY R. A. BULL

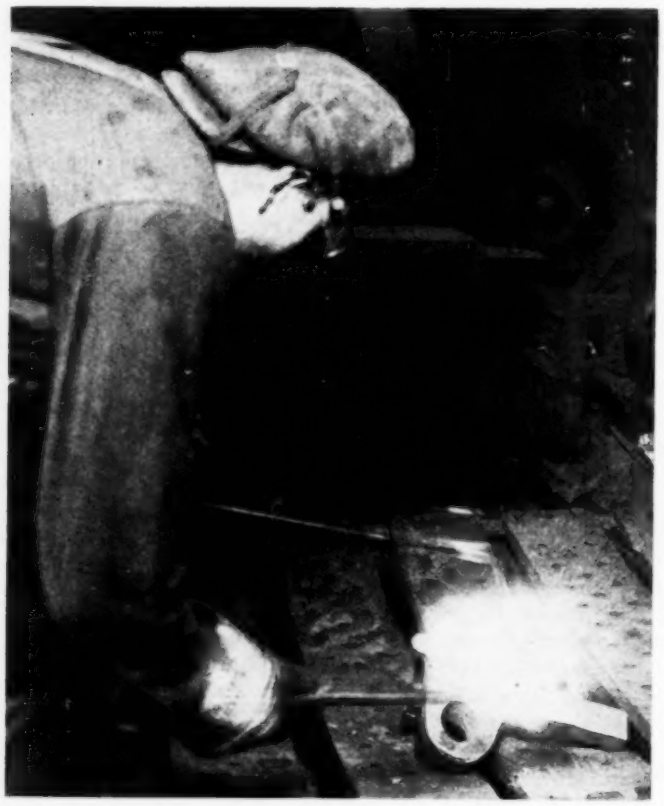


Fig. 1—Improving the Surface Appearance with Oxyacetylene Welding

EXTREMELY interesting and diversified articles on the subject of welding have appeared recently in business and technical papers. They have exploited the improved equipment and methods intelligently developed, and indicated useful applications of welding where it now is employed to but slight extent. The subject has so many important aspects for users of steel castings that a discussion of the art as utilized by steel foundrymen and as capable of use by those who buy steel castings seems advisable.

Consumers of the product of the steel foundry are justified in wanting to know (a) what are the properties of metal formed during a welding operation on a casting or other part made of steel; (b) what happens to the surface adjoining the defect when a steel casting is welded; (c) what methods may be utilized after welding a casting to improve it; (d) what practical methods may be employed for testing welds; (e) when it is permissible to weld a steel casting; (f) what may be reasonably expected in the near future in connection with ingenius developments that might improve welds in steel castings.

In the first place, welding by means of gas or the arc, sometimes termed fusion welding, is in reality not welding in the technical sense originally defined by lexicographers, because it is not an absolutely homogeneous intimate union. The uniting material has characteristics of its own. When gas or arc welding is employed to join two pieces of steel, the heat is sharply localized and quickly developed to the point where a molten condition of the metal in a small area exists. Some persons might assume that since the steel used for filling-in is liquefied, it unites with the adjoining liquefied mass representing each side of the weld, to make a combination that will, when cooled, have satisfactory elements of homogeneity. When a weld is made in the customary manner the process of melting exposes the liquid mass to the atmosphere. Steel is an alloy always containing carbon, manganese, silicon, phosphorus and sulphur. If it is of a special grade it may contain other elements. The melting temperature by exposing the material to atmospheric conditions causes the carbon, manganese and silicon in the liquefied steel to combine partially with the oxygen in the air, bringing about a substantial loss to each of these highly important elements, through oxidation. This operation itself produces certain oxides of nonmetallic characteristics, impossible to separate wholly from the metal proper after it becomes solidified.

When the filled-in metal freezes it generally has many of the peculiarities of badly made steel, containing numerous nonmetallic inclusions. Not infrequently these inclusions are so large as to justify the term enclosure, implying something larger than an inclusion and visible to the naked eye. Further, the granular structure of the welded metal often has the appearance of being burned. The rapid cooling to which the welded part is subjected generally causes a small grain size of the filled-in metal. Large crystal growth in steel often is due to slow cooling, not typical of a welding operation.

In the conscientious effort to obtain

IN VIEW of the widespread attention now being given to applications of welding, producers and users of steel castings will be interested in the accompanying article which deals with the policy on welding adopted by a group of electric steel foundries.

The author, R. A. Bull, is director of the Electric Steel Founders' Research group, 541 Diversey Parkway, Chicago. The article is reprinted in slightly abridged form from the October, 1927, issue of "Research Group News," by permission of the Electric Steel Founders' Research group.

as nearly as possible for the filled-in metal the chemical characteristics of the adjoining material, experimenters have used welding rods containing high percentages of the oxidizable elements in the hope that when lowered in percentages these might finally compare favorably in proportionate amounts with what was in the parent metal.

Other expedients have been employed for the purpose of securing the most satisfactory results from rods selected with every consideration for the result of the chemical and physical reactions formed. Despite these and other efforts, the best commercial welding practice of today fails to maintain the chemical composition, the physical structure, or the freedom from nonmetallic inclusions in the union formed by new metal between two sections of steel joined by welding with gas or with the arc.

Except for the nonmetallic enclosures, a typical weld much more nearly approaches chemically pure iron than it does steel. Thus it is found to possess a lack of ductility values, which are unobtainable with pure iron but are common to the customary grades of steel. These qualities would exist if it were possible to exclude all nonmetallic matter as it is formed by the welding operation.

The degree of care and skill exercised by the welding operator has considerable effect on quantities of nonmetallic matters remaining in the steel part that has been welded. The personal factor is also important between somewhat narrow ranges in the oxidation of useful chemical elements that confer toughness and strength. The mechanical and chemical features of the welding rods are important factors. The heat employed, either produced by the arc or by gas, is an essential feature, since naturally the best results follow steady maintenance of the required temperature.

We have seen how the filled-in metal produced under conditions that now prevail in commercial welding practice necessarily differs from ordinary steel that is rolled, forged or cast. The question immediately arises, what may be done to improve this newly formed metal. Undoubtedly there is opportunity in many cases for injurious strains to be set up, not only in the weld proper, but also in the adjoining portions of the steel part, by the extremely rapid cooling that is the result of exposure to the atmosphere, of a metal subjected to high temperature.

Remembering that the annealing of steel has for one important purpose the relieving of internal strains, we may understand readily enough that an annealing operation improves the properties of the solidified, filled-in metal and the adjacent parent metal. This is why some steel foundrymen require that a casting that has been welded in any portion, expected to withstand at least a fair amount of stress, shall be heat treated after the welding operation, irrespective of the fact that it may have been thoroughly heat treated previously.

In the effort to convince engineers regarding the advantages of welding, some persons have pointed to the failure under laboratory test, of specimens, not in the rupture of the filled-in metal, but in that of the parent metal adjoining. This by no means proves the superiority of the newly deposited metal as compared with the original steel joined by welding. Here the deleterious effects of rapid chilling of metal that has been made red hot may be demonstrated frequently. The temperature from the gas flame or arc often is so great as to injuriously affect steel that does not reach a molten condition, especially if it is not subsequently heat treated. The extent of injury naturally depends on the composition of the parent material. It may or may not be extremely susceptible to change in physical properties as the result of temperature.

There seems to be no method of improving a welded casting except by normalizing or otherwise annealing it. The same statement applies to any steel part that has been welded.

Unfortunately, as will be admitted by the most enthusiastic exponents of welding, it is impossible to ascertain whether a weld has been satisfactorily performed except by destroying it. There is comparatively little we may do besides assuring ourselves that equipment is satisfactory, and that care and skill are exercised by the operator. It is feasible to make occasional test welds. But it avails little to have the operator realize that these welds are to be tested. For that reason pieces butt-welded, obviously made for the purpose of pulling or bending under test, do not adequately safeguard those who wish evidence of satisfactory routine work.

A better plan is that employed by foundries in the Electric Steel Founders Research group, where every week carefully selected commercial castings are given with other castings to each welding operator, who repairs them in the customary way without any knowledge except the realization that in the course of his regular work he is getting defective pieces to be welded which are to be destroyed for examination of the welds by his boss. There is no way in which he might reasonably guess what castings are to be cut to pieces for determining the satisfactoriness of the welding operation. The procedure is a safeguard that is practical to impose. It is one that might be utilized by those interested in steel parts produced outside the foundry.

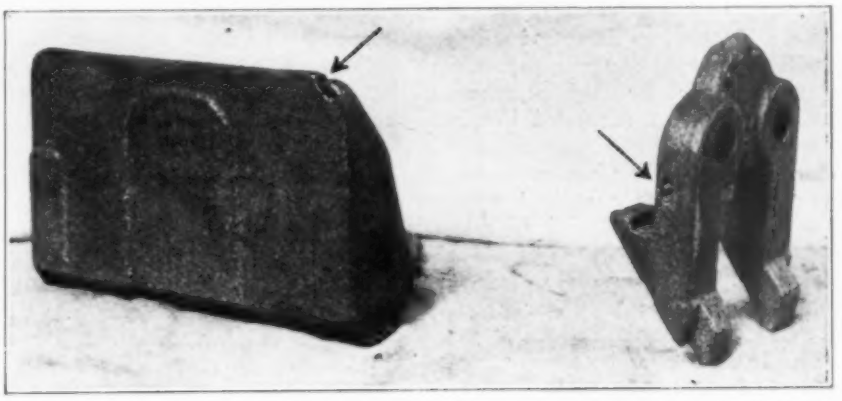


Fig. 2—Group castings having relatively unimportant defects typical of those welded

While the tensile test gives valuable evidence regarding ductility, it does not fully meet the requirements of those particularly concerned about resistance to shock. Unfortunately the bend test has not been standardized. It seems logical that it might be applied under carefully imposed, uniformly established conditions that would result in much of value to engineers, including those interested in the effectiveness of the welding operation.

Recently W. B. Miller, Union Carbide & Carbon research laboratories, proposed, before the American Welding society, a method of making the bend test as applied to welded specimens, which appears to have useful possibilities. This will doubtless stimulate other engineers to study the question, and it is to be hoped that before long methods for bend testing may be utilized for unwelded and

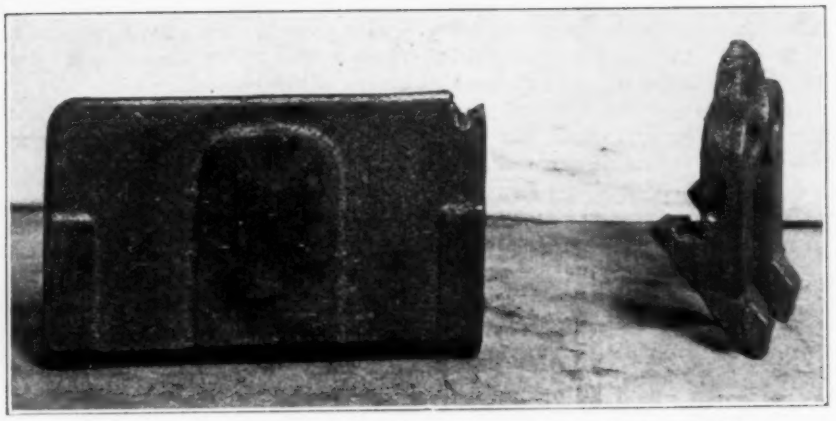


Fig. 3—Defects carefully chipped out for effective welding

welded steel specimens in a manner that will usefully supplement the information from other testing methods. Mr. Miller advocates a measurement of the percentage of elongation over the weld area, on the outside of the bent portion. If this practice finds favor it will be necessary to standardize means for holding the test-piece and applying regulated bending stresses to it.

The reader will readily understand from what has been said that foundrymen in the Electric Steel Founders Research group feel it advisable to restrict their welding operations to those superficial defects that do not influence the serviceability of the piece. In other words, welding is employed for the sake of appearance. Inspection standards require as an essential procedure that any sand, slag, or other non-metallic matter that may form an enclosure on the surface of a casting, thereby marring its appearance for any purpose where finish is important, shall be thoroughly removed before the welding operation is started. If dirt is present when the welder applies his arc or his torch, it will melt, form slag, and thus prevent, by the nature of its composition, the desired union of the metal from the welding rod with the metal of the casting.

Furthermore, it is prohibited that any welding be done without the approval of a responsible plant executive, on a location that causes any doubt regarding the effect of the weld on the serviceability of the casting. This necessitates the most careful discrimination by persons not likely to be influenced by considerations of low production costs.

Fig. 2 shows two steel castings, each of which has a small defect, indicated by an arrow. To some extent the defects mar the appearance of the surfaces but they interfere in no degree with the application or the dependability of the castings. Fig. 3 shows the way in which non-metallic matter is carefully chipped out of castings prior to welding. Fig. 4 shows the castings after welding has been performed and after the welded surfaces are made smooth by finishing operations. For pictorially illustrative purposes, it would be superfluous to show the castings after the final but important operation of heat treating is given.

Recently those who now employ welding with careful discrimination and who would profit if it could be made more dependable, have been much interested in the development of methods for making welds under vaporous conditions that prevent exposure of the welding operation to the atmosphere. Here we find a useful objective being sought, and one apparently that has been of promising results in the laboratory. This method has not been applied to any extent commercially, doubtless due in no small degree to the disconcerting fact that such electric welding under gaseous, nonoxidizing conditions has thus far necessitated amperages and voltages that differ radically from those obtainable with the best electric welding equipment now in general use. Experimenters are still at work on this interesting problem of great significance in these modern days.

Designing is a responsible detail of engineering. He who approves for a shop order the drawing of a metal part that is expected to withstand successfully many severe shocks and strains, should remember that commercial practice in the manufacture of any material is not always typical of work done for laboratory tests; that the personal equation is an element that to large extent is uncontrollable in the best regulated establishments, domestic or industrial; that it is wholly unscientific and might be utterly disastrous to gage the resistance of any metal part to shocks, by no more than reasonable values for yield point and ultimate strength under tension tests.

Book Review

A.S.T.M. Tentative Standards, 1927, paper, 6 x 9 inches, 824 pages, published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland for $7 and in cloth, $8. In London, 416-17 Caxton House, Westminster, the prices are 35s and 40s respectively.

Each year the American Society of Testing Materials publishes a volume containing the tentative standards which are distinguished from the standards in that they are proposed standards which are printed for one or more years to elicit criticisms and suggestions before being formally adopted as standards by the society. This volume contains 175 standards of which 18 are devoted to ferrous metals, 20 to nonferrous metals, 26 to lime, cement, etc., 31 to preservative coatings, 39 to road materials, 3 to water-proofing and roofing materials, 21 to rubber products, insulating and textile materials and 17 to coke, coal, timber and miscellaneous materials.

Elected President

Samuel Wilson Parr, professor emeritus of industrial chemistry, University of Illinois, Urbana, Ill., has been elected president of the American Chemical society for the ensuing year.

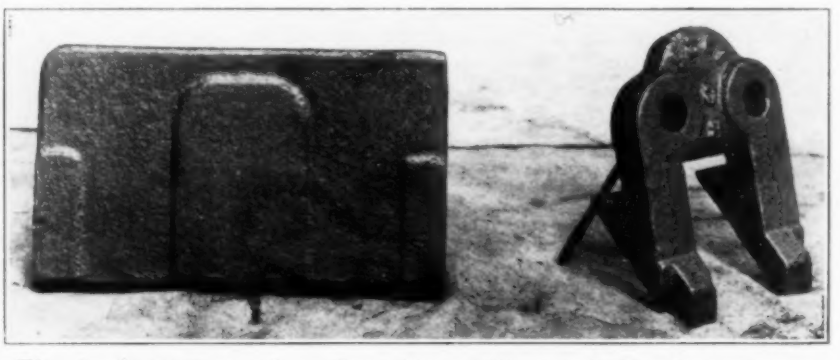


Fig. 4—Appearance of casting after welding and dressing, preparatory to heat treatment

SELLING
Is Foundry Industry's GREATEST PROBLEM

By Jay J. Seaver

WHAT is wrong with the foundry industry? How many times do you hear this question from one or more of the great body of men who guide the destinies of that great industry, which is so essential to the welfare and happiness of the human race? It is not necessary to talk long with a foundry manager, owner or stockholder before a vivid picture is painted of an industry rapidly approaching a crisis. Constantly you hear the same old story of low prices, keen competition and no profits. Some even admit that they have business on their books which will net a return in some cases considerably below the cost of manufacture. When criticized, they offer many excuses to justify an action which sooner or later is going to undermine the financial structure of the industry.

Before discussing the various underlying factors contributing to the deplorable situation which seems to exist in the foundry industry today, it may be of interest to sketch briefly the methods which have been followed in building the business of the Pulaski Foundry & Mfg. Corp., Pulaski, Va., with which the writer is connected. The Pulaski company is managed and controlled by Arthur G. McKee & Co., Cleveland, blast furnace and steel plant engineers and contractors. Among other things the McKee company manufactures blast furnaces and a special revolving charging distributor for blast furnaces, all of which require a large tonnage of miscellaneous size castings.

Previous to the acquisition of the Pulaski plant several years ago, the McKee company purchased all of its castings on the open market and thus secured an accurate conception of the methods followed by foundries in selling castings. The reaction of casting buyers to merchandising methods of foundry companies also became apparent. This knowledge became of considerable value when later the company increased the scope of its activities and became a producer and a seller of castings.

About eleven years ago the writer was supervising the erection of a blast furnace in Pulaski, Va. Many of the castings used in the fabrication of the furnace were made in a local shop which was purchased by a chemical company about that time to take care of its war time needs. The manager of that foundry then became enthusiastic over the possibility of building another foundry in Pulaski to do that type of work. After trying without success to interest the McKee company in the proposition, he secured backing and built another jobbing foundry in Pulaski. Sometime later the McKee company deemed it advisable to secure a foundry and acquired that plant.

The author has been connected with the foundry industry directly for five years, a sufficient length of time to enable him to get a true picture of the grief, the trouble and the pleasure associated with the business. The Pulaski foundry has been faced with its share of problems and while many are common to prac-

Heads Southern Foundry

JAY J. SEAVER, the author of this article, has been identified with engineering and construction work in the iron and steel industry for the past 16 years and for five years has been president of a southern gray iron jobbing shop. He was graduated from the University of Michigan, Ann Arbor, Mich., in 1912 with a degree in engineering and immediately was placed in charge of the experimental department of the Penn Motor Car Co., New Castle, Pa. About a year later he became connected with Arthur G. McKee & Co., Cleveland, blast furnace and steel plant engineers and contractors. Later he was made superintendent of construction and in 1923 was elevated to the vice presidency of the company. During the past five years he has been president of the Pulaski Foundry & Mfg. Corp., and the Pulaski Engineering Works Inc., both of Pulaski, Va. The former is a foundry specializing in gray iron castings and the latter is a structural steel fabricating plant.

tically all foundries, a few are duplicated only a few times in the country.

The cry probably will be raised immediately that this foundry may be included in the rapidly increasing class of shops which are maintained as a department of a manufacturing establishment and that the problems of the ordinary jobbing shop do not in any way parallel those of the southern shop. However, this is not true. The Pulaski company is required to furnish bids on all castings needed by the Arthur G. McKee company and must, in all cases, meet the competition of all outside foundries bidding on the work. In case the Pulaski company does not meet outside competition, the business goes to the company with the lowest quotation, providing of course that the McKee company is satisfied that the successful bidder will produce castings of a quality to meet the specifications.

Markets Far From Plant

Orders of the McKee company amount to only about 30 per cent of the capacity of the Pulaski foundry. This makes it necessary for the company to meet competition of other jobbing shops scattered throughout a considerable area to keep the plant operating on an economical basis. The company is handicapped by being located several hundred miles from its markets. The little city in southwestern Virginia is approximately 600 miles from Philadelphia, 500 miles from Pittsburgh and 425 miles from Cincinnati. A large percentage of the castings produced are sold in these northern markets and the selling price plus freight must compete with the selling price of the foundry located nearer the consumer. Such a handicap demands either minimum producing costs or quotations below the actual cost of production. However, the Pulaski Foundry & Mfg. Corp. never has been guilty of the latter practice, although in a few instances castings have been made practically on a basis of cost plus overhead.

It may be well to point out the advantages which may be derived in the future due to the location of the plant. Undoubtedly the South is the fastest growing industrial section in the country. Each year a greater tonnage of castings will be required by the cotton mills, the sugar mills, the oil fields and other industries which are being established throughout the South at a rapid rate. In time the distance between the Pulaski foundry and its markets may be shortened, thus cutting the transportation costs and increasing the ease of meeting competition. But in the meantime it is necessary to sell castings where castings can be sold.

The foundry has been aided greatly by the labor situation in that section of the country. It is possible to obtain exceptionally good workers who in a short time develop sufficient skill to perform the various operations in the plant. The cost of labor is exceptionally low. Because of the low labor cost the foundry is aided greatly in meeting competition in distant markets. However, other considerations play an important part in the success of the plant.

The company has made a careful study of costs and has included every item which constitutes a part of the expense in producing castings. Some difficulty has been encountered in making a man, who has spent most of his life in the plant, see the necessity of keeping voluminous records for the purpose of obtaining complete cost data. The foundryman of the old school too often feels that a satisfactory figure for quotations may be obtained without so much red tape and it is difficult to change that opinion. While this difficulty was encountered by the company it has been solved in a very satisfactory manner. A practical foundryman with an engineering training now is connected with the plant, and the inclination of the engineer to make a thorough study of every detail of plant operation is resulting in cost records which include all items of expense.

Advertises Products

For several years the company has carried on an extensive advertising campaign. Products have been advertised in several business publications covering the field in which the type of castings produced by the company is sold. Attractive calendars have been sent to a selected list of customers and prospects each month and a special advertising feature has been mailed out around the holiday season. Exceptionally satisfactory results have been obtained from the money expended in the various forms of advertising.

Until recently, when the company placed a salesman on the road, much of the contact work between the company and prospective customer was done by the writer. Other business interests necessitated frequent visits to cities in which various customers were located. On such occasions, a special effort was made to see all customers and prospects in the district. At such times orders were secured or the groundwork was laid for sizable orders which usually would develop in the near future. At present the company is watching with interest the experiment of a salesman spending his entire time distributing the products of the company.

Gray iron castings from one pound to 3000 pounds and steel castings up to 7500 pounds are made in the plant. The total daily melt of the foundry is in the neighborhood of 5 tons and is poured chiefly in castings for blast furnaces, sugar mills, chemical plants, oil refineries, etc.

Seeks Cut in Costs

A short time ago our plant was visited by a foundryman from a neighboring town. His plant manufactures a specialized product which must be sold in a highly competitive field. He told the story of how his salesmen have tried time and again to secure business. He explained that the company had gone over the production costs carefully in estimating on work and at last had arrived at a figure which included only the cost of manufacture plus overhead. However, when the bids were opened, the competitor's bid was below his cost plus overhead quotation. Finally in desperation he stated that the salesmen had met the competitor's price and to express it in slang—had passed the buck to the manufacturing department.

The foundryman felt that he must do one of two things, either reduce the cost of manufacturing his product or increase the price obtained for the castings. Since the possibility of increasing the selling price of the castings appeared absolutely out of the question, he hoped that by some form of magic as fantastic as any described in fairy tales, the problem of lower costs could be solved.

At his request we checked over the cost system employed in his plant and found that all items of cost had been included. His manufacturing processes were compared with other plants with which we were familiar and it seemed that little could be gained by changes in practice. After studying over the problem presented by the neighboring foundryman, it appears that he is up against a stone wall, for unquestionably the only way for him to show a profit on the castings sold is to increase the selling price. Like hundreds of others now faced with a similar problem, the foundryman is much concerned over the situation.

Without a doubt the foundry industry, taken as a whole, does not know its costs. While it is true that numerous plants have gone deeply into the subject of costs, have ab-

sorbed the information which has been secured through the researches of certain organizations and the work of individuals, entirely too many plants arrive at a cost figure by methods which would make many of the get-rich-quick schemes appear exceedingly tame. A foundry must know its costs before it can make a quotation which will assure a profit, providing of course the job is secured. It is necessary that every item of expense developing in the production of castings be included. How many plants figure the operating costs carefully and then overlook, or perhaps purposely forget to include the overhead charge?

Equipment Saves Costs

The modern foundry rapidly is becoming mechanized. Equipment has been developed which eliminates the human element in controlling many of the variables encountered in foundry practice and makes it possible for the casting shop to produce a more uniform product, in larger quantities and in many cases at a lower price. Economies secured through the application of machines have forced many plants to buy equipment on a large scale to meet competition. However, all too many foundries fail to consider the investment in equipment when figuring cost data. They forget that the money spent for equipment constitutes an overhead expense and that the selling price of the plant product should include the interest charge on the investment.

How many foundries do you think look ahead to a time when the equipment must be scrapped, either because it is worn out or obsolete, and provide a way for writing off the initial cost of equipment—when that time arrives? Perhaps only a few. In all too many plants no attempt is made to add the depreciation charges to the cost figures determined for the purpose of arriving at a selling price for the castings. However, when the machines are worn out or become so obsolete that the foundry must buy new equipment, the foundryman must realize that he has presented his customers with an amount of money equal to the cost of the equipment. He probably will find it exceedingly difficult to secure sufficient funds to make the necessary replacements. Other costs which should be included in the overhead charges, often are overlooked.

To one experienced with other lines of industrial activity, foundry practice from necessity seems to include many factors of waste. High temperatures of the metal soon burn out the sand in the large foundry, tons of that essential material are scrapped yearly. If the plant is located in the city with no dump near the plant, a certain amount of expense is incurred in disposing of the waste sand. Various kinds of supplies are necessary in foundry practice, and this item of cost must be included in the selling price of the casting.

A certain amount of expense is involved in keeping the various records which follow the job through the production steps. Records must be kept in each department, such as engineering, patternshop, pattern storage, molding, melting, core making, cleaning, shipping, etc. Practically the same number of records must be kept for every order, whether large or small, and it is necessary that every order bear a certain percentage of the total cost of keeping the records. Some foundrymen have adopted the practice of determining a standard overhead or burden charge to include all of the clerical cost.

Cost System Weak

While considerable research has been undertaken by the American Foundrymen's association, Steel Founders' Society of America and other organizations, little has been done toward standardization of cost systems in the industry. One foundry may be using a system which has been designed by an expert in foundry cost accounting. It may include all of the various items of cost, and arrives at a cost figure for each operation which is absolutely correct. A neighboring foundry may use a system which has developed gradually in the shop as the need for cost information became more acute. It may include all costs, but the chances are that something has been omitted. Undoubtedly a cost figure is secured, but it is doubtful if it represents the true production costs. Supposing that the second foundry does omit some item of cost which permits the owner to make a lower quotation than the first foundry, and still appear to make a profit, how can these two shops compete fairly? The first plant either must cut prices to meet this unfair competition or must have something to sell in addition to just plain castings.

This leads to the second reason for the present situation in the foundry industry. The industry as a whole needs better merchandising methods. Much attention has been paid in the past few years to perfecting the various phases of foundry practice. Work has been carried on in solving the problems of preparing, testing and reclaiming molding sand. Other supplies such as core oils, facings, partings, etc. have been investigated thoroughly and the results presented to the industry for general use. Equipment manufacturers have spent huge sums to give the industry fine equipment. However, little has been done to teach the foundryman how to sell his product. Perhaps the statement that the foundryman has done little to improve his selling methods would be more nearly correct.

Competition Is Keen

The foundryman also is being pushed hard by competition from without. The industry is finding competition from other methods of shaping, such as forging, pressing, drawing and also from welding. The competitors of the foundry have carried on intensive advertising campaigns to increase the sale of their products and while the malleable and steel foundries have advertised the merits of their products with splendid results, no concerted effort has been made to further the cause of the gray iron foundryman.

It is absolutely necessary that the foundryman know his markets if progress is to be made in the sale of the product. Failure to study intensely present market conditions as well as future market possibilities disarms the foundryman and makes it exceedingly difficult to meet the growing competition. A few of the more progressive foundries have spent time and money in surveying markets, and they have found that it pays. Information secured from a market research enables the foundryman to determine the points where the greatest sales effort must be placed, enables him to combat the competition offered from within and without the industry and permits him to enlarge his business by determining new outlets for his product. Undoubtedly the foundryman cannot increase the amount of castings sold unless he knows his markets.

After the foundryman has secured the correct information on costs and has made a careful study of his markets, he should undertake to sell his castings through the various agencies at his command. In recent years a greater number of salesmen have been employed to sell foundry products. Where the foundry manufactures a special line of castings which can be sold only to a limited number of customers, the problem of a sales force is relatively simple and often a single man will be able to represent the foundry in a highly satisfactory manner. However, other foundries producing a wide variety of

(*Concluded on Page* 59)

Metals and Melting

How Metallurgical Problems Have Been Solved in Gray Iron, Malleable and Steel

Methods of Reducing Internal Shrinkage

Question: We are sending a section of a bridge wall and seat of a valve. You will note at the point where the bridge wall and seat comes together there is a black spot which looks as if some foreign matter had been trapped in the iron. We should like to have your opinion as to what is causing this. The valve body was molded with a chill inside where the seat and wall come together. The analysis of the iron used in making this casting was as follows:

	Per cent
Silicon	1.37
Sulphur	0.10
Phosphorus	0.272
Manganese	0.50

The mixture was made up of the following:

45 per cent malleable pig iron
30 per cent semisteel scrap
25 per cent steel

Answer: The black spot in your casting is due undoubtedly to internal shrinkage. Now, of course, all iron has a tendency to shrink and this must be overcome by getting the composition of the iron so as to give you as little shrinkage as possible. Shrinkage also can be lessened by pouring the castings white hot. It would also be of help if you could cut down the thickness of the heaviest section in the casting and make the light section change into the heavier section less abruptly. Another thing which could be done to decrease the tendency to shrink would be to gate the casting as far as possible from the heavy section, then the iron would be somewhat cooled before it reached this section and the heavy section would set almost as quickly as the lighter section. A reduction of the amount of steel scrap to 10 or 12 per cent would also have a tendency to lessen the shrinkage.

Grate Bars Fail

Question: We make a large number of grate bars and lately have been receiving complaints on lack of service. Could you give us some information on the best analyses for grate bar iron?

Answer: You do not state whether or not you are using white cast iron for the grate bars. It is necessary to have as high a combined carbon as possible without getting the iron brittle. The manganese should be low and the sulphur fairly high.

Two suggested analyses are as follows:

	Per cent	
Silicon	1.75-2.00	0.8-0.9
Sulphur	0.10-0.12	0.20-0.25
Manganese	0.50	0.2-0.3
Phosphorus	0.20-0.50	0.30

The low-silicon, high, sulphur iron should be made in a small cupola or air furnace as a specialty. This iron would also have to be annealed at about 500 degrees Fahrenheit to release any strains.

If the grate bars are kept free from ashes and clinkers, we believe that you should have no trouble with first mixture given. Most difficulty with grate bars occurs not so much with use as with abuse of the castings.

Carbon Is on Surface

Question: We have received a car of machine-cast pig iron and quite a few of the pigs have a deposit on top which looks like graphitic carbon mixed with slag.

Upon taking the matter up with the furnace company, it advised that this condition is characteristic of machine-cast pig, and is caused by the cooling process. It says that this material is graphitic carbon, but that we should have no trouble in using same as the carbon would again be taken up by the iron in melting in the cupola.

Do you consider that this statement is correct; that is, that the iron will again take up this free carbon, or, will it slag off to a greater extent than if mixed in the pig?

Answer: It is quite common to find graphitic carbon on the top of machine-cast pig iron and it will also be found on the top of sand-cast pig iron at times. This is due to the iron containing more carbon than it normally can hold and you will find that the chilled pig iron contains sufficient carbon for your needs without the carbon that has separated out.

Melting in the cupola will allow the pig iron to either take up or lose carbon to the extent necessary to normalize the carbon content. Some pig iron, as it comes from the blast furnace, has too little carbon and takes up carbon from the coke on being melted in the cupola. The reverse is also true, and in this case the pig iron will lose carbon in being melted in the cupola. We do not feel that there is any objection on account of the free carbon on the pig iron furnished to you.

Excess Air Retards Heat

Question: We installed a coal-fired air furnace in our gray-iron foundry. It required 7 hours to melt the first heat, and 50 per cent of the silicon and manganese was lost. The iron in the castings was practically white. We would like to know what was the cause of the slow melting and the high loss of silicon and manganese.

Answer: Undoubtedly your trouble is that you use an excess amount of air. The oxygen in the air oxidizes the metal and the silicon and manganese. The excess volume of air also carries away heat and this results in slow melting. You should be sure you have a gas, or long flame, coal and then see that the volume of air is correct so as to give you a long flame, sharp near the bridge wall at the stack.

Makes Mine Car Wheels

Question: We are preparing to cast mine car wheels and would like to know what mixture should be used in the cupola.

Answer: Mine car wheels should have a metal containing between 0.2 and 0.4 per cent phosphorus, preferably below 0.3 per cent; manganese between 0.60 and 0.80 per cent and sulphur below 0.100 per cent. The silicon will vary with the design and weight of the wheel but in most wheels should be between 0.75 and 0.80 per cent. Your mixture should be made up to conform to these limits. It is a good idea to use approximately 40 per cent car wheel scrap, 5 per cent steel scrap and the remainder pig iron. Many foundries making mine car wheels use charcoal pig iron. Of course, there is much more in making mine car wheels than the composition of the metal, as the method of melting the iron, the temperature at which it is poured, the rate of pouring, and the method of annealing are all important considerations.

Determines Properties *of* High Silicon Irons

By Raymond H. Hobrock

CAST irons containing considerably higher silicon than is found in the ordinary commercial types have been found extremely useful in resisting acidic corrosion, and find employment in the chemical industries. These irons are known under a variety of trade names and contain from 13.5 to 15 per cent silicon. The carbon of these alloys is low, ranging from 0.2 to 2.7 per cent and better may be classed as steels rather than cast irons. Most of these irons are silvery white in color, are hard and brittle and cannot be machined.

Processes for the manufacture of these high silicon alloys are patented and consist of adding molten ferrosilicon in the proper amount to molten iron that has had its carbon content adjusted previously by some means. After some study the author decided that an alloy with a high silicon and high carbon content corresponds closely with an alloy that might be produced in the gray iron foundry by additions of ferrosilicon to molten gray iron in an electric furnace.

Knowledge of the properties of such high silicon alloys may be useful to the foundryman who is called upon to manufacture corrosion resisting castings which are used in apparatus for handling acidic sewage and mine water drainage, apparatus exposed to sea water and that used in making vinegar or other food stuffs. To examine the effects of silicon content on the physical properties, four different types of test bars were made which included two standard arbitration bars, and one each of a chill bar, step bar and shrinkage bar.

The arbitration bar was made in accordance with the specifications of the American Society for Testing Materials and the American Foundrymen's association and was 1.25 inches in diameter and 15 inches long. The chill bar, shrinkage bar and step bar were made in the same green sand mold and poured at the same time. The chill bar is 6 x 1 inch square and is cast against heavy chills on all sides except the ends. The shrinkage bar is 1 inch square and cast in a standard clamp exactly 12 inches between jaws. The step bar has 5 steps of different thicknesses, but with the same length and width. Thicknesses of the steps are 0.25-inch, 0.5-inch, 1 inch, 2 inches and 3 inches. It was cast on the side as shown in Fig. 1.

KNOWLEDGE of the physical properties of alloys that contain a higher silicon content than the ordinary gray iron castings is useful to foundrymen who manufacture or contemplate manufacturing castings of that type for resisting corrosion. This article which presents the results of a number of tests is abstracted from a paper prepared in the engineering experiment station, Purdue university Lafayette, Ind., with which the author is associated.

To effect the smallest possible change in other elements besides silicon that ordinarily are found is cast iron, a large quantity of iron was cast from the cupola into small molds which later was melted in the electric furnace with additions of ferrosilicon to produce the required alloy. The stock iron was melted in cupola of the department of mechanics of Purdue university, and consisted of 50 per cent returned scrap and 50 per cent pig iron. The exact composition of the iron was not determined, but the approximate composition was known.

The stock iron was melted in a laboratory type arc furnace manufactured by the Pittsburgh Electric Furnace Corp., Pittsburgh, lined with ganister with a hearth 8 inches in diameter and 10 inches deep. Silicon additions were made with 50 per cent ferrosilicon and were based on a silicon content in the stock of 2.5 per cent and 50 per cent in the ferrosilicon. The actual procedure giving the best results was to melt a portion of the iron, get the furnace hot

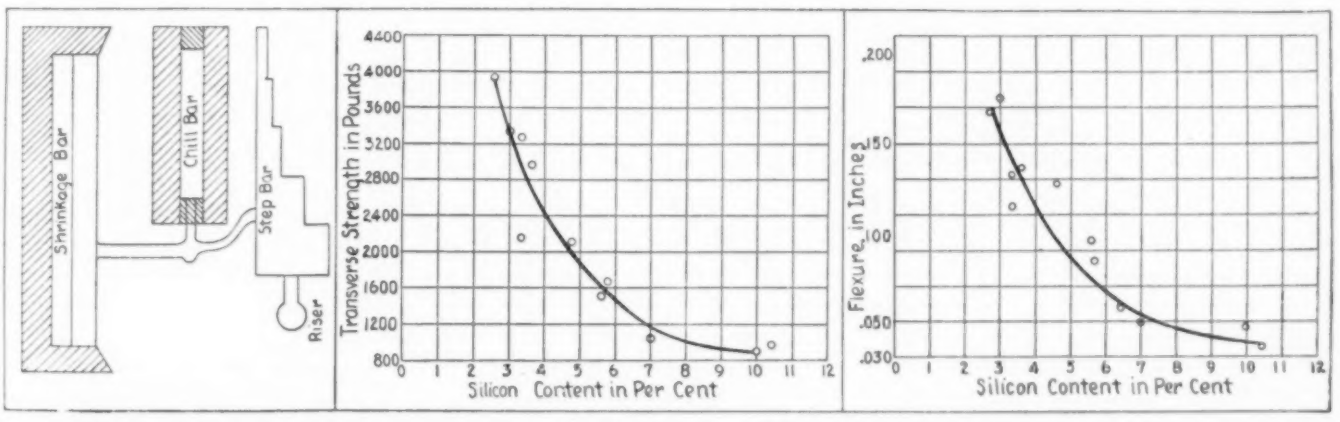


FIG. 1—SHOWING THE ARRANGEMENT OF BARS IN THE MOLD. FIG. 2—CURVE DEPICTING VARIATION IN TRANSVERSE STRENGTH WITH SILICON CONTENT. FIG. 3—CURVE SHOWING RELATION BETWEEN SILICON CONTENT AND FLEXURE

Table I

Analyses of Bars

No.	Total Carbon Per Cent	Free Carbon Per Cent	Comb. Carbon Per Cent	Silicon Per Cent
1	2.96	2.36	0.60	2.69
2	2.90	2.64	0.26	3.02
3	2.80	2.58	0.22	3.33
4	2.92	2.75	0.17	3.39
5	2.63	2.77	.....	4.62
6	2.58	2.77	.....	5.62
7	2.42	2.61	.....	5.70
8	2.17	2.10	0.07	6.97
9	2.08	2.18	.....	9.98
10	1.32	2.14	.....	10.45
11	2.86	2.68	0.18	3.62
12	2.57	2.64	.....	6.44

Table II

Transverse Strength of Bars

No.	Silicon Per Cent	Average Transverse Pounds	Average Deflection Inches
1	2.69	3910	0.168
2	3.02	3342	0.175
3	3.33	3255	0.132
4	3.39	2230	0.114
5	4.62	2145	0.127
6	5.62	1515	0.095
7	5.70	1650	0.084
8	6.97	1047	0.049
9	9.98	860	0.047
10	10.45	920	0.034
11	3.62	2980	0.136
12	6.44	1082	0.057

and then add portions of ferrosilicon, reheating and stirring in between, and finally adding the remaining iron. With higher silicon additions it was necessary to add all the iron before making additions of ferrosilicon.

Large amounts of ferrosilicon do not alloy well even though precaution is taken to have the ferrosilicon in the form of a fine powder. It is necessary to heat repeatedly and stir well after each addition. Further difficulty was encountered with the bottom metal freezing while the top metal was at a high temperature above the melting point. Consequently, the temperature had to be raised considerably above that otherwise necessary and did not permit the best control of pouring temperatures. Temperatures of the molten metal were obtained with an optical pyrometer calibrated before use. In making the observations, the ladle was tipped to give unobstructed view of the metal, the slag scraped from the surface and the observation made. Several observations were made each time.

In some cases where the temperature of the metal had been quite high, the metal was allowed to cool before pouring. This depended upon the apparent viscosity of the metal as determined by the feel of a stirring rod inserted in the metal. Only 25 pounds of metal were melted and poured at one time. This meant one heat for the standard test bars and one heat for the other test bars. Any excess metal was pigged and not used again. After each heat the ladle was scraped thoroughly, and frequently after each similar pair of heats, the refractories were renewed entirely.

Chemical analyses were determined with difficulty due to the insolubility of the alloys in ordinary acids and the large amounts of silicon present interferred with the determination of other elements. The latter difficulty probably was due to the absorption of some of the salts of the element in the silica gel. The chief difficulty and one that as yet has not been solved satisfactorily was the determination of the total carbon by the combustion method. In the presence of much silicon all of the carbon cannot be oxidized. Results are consistent in themselves but are not true values as may be seen in the results shown in Table I.

With a silicon content of 4.62 per cent and above, the free carbon content apparently is greater than the total carbon content. All ordinary methods for the determination of carbon in the presence of much silicon were tried. They consist chiefly of two procedures; the annealing of the sample and the use of a strong oxidizing agent mixed with the sample in the combustion boat. The latter method gave fair results when red lead was used as the oxidizing agent. However, the slag formed and the vigorous action of molten red lead attacked the boat and in one case ruined an expensive fused quartz combustion tube. Higher temperatures and other methods were tried without results so that finally attempts were abandoned temporarily without serious results, since in irons with higher silicon content almost all of the carbon is present as graphite.

Free carbon was determined in the ordinary manner. All samples were dissolved in a mixture of 90 per cent hydrochloric and 10 per cent con-

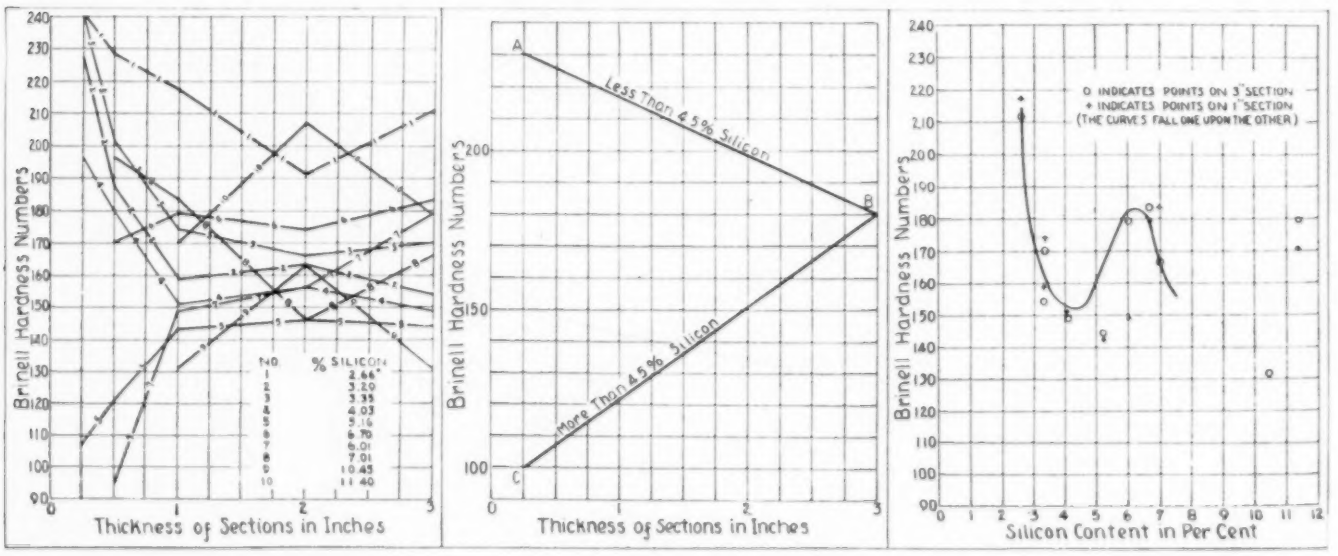


FIG. 4—VARIATION OF BRINELL HARDNESS WITH THICKNESS OF BARS AND SILICON CONTENT. FIG. 5—SHOWS GENERAL TENDENCY OF HARDNESS CHANGE FOR DIFFERENT THICKNESSES AND SILICON CONTENT. FIG. 6—VARIATION IN HARDNESS OF TWO THICKNESSES WITH SILICON CONTENT

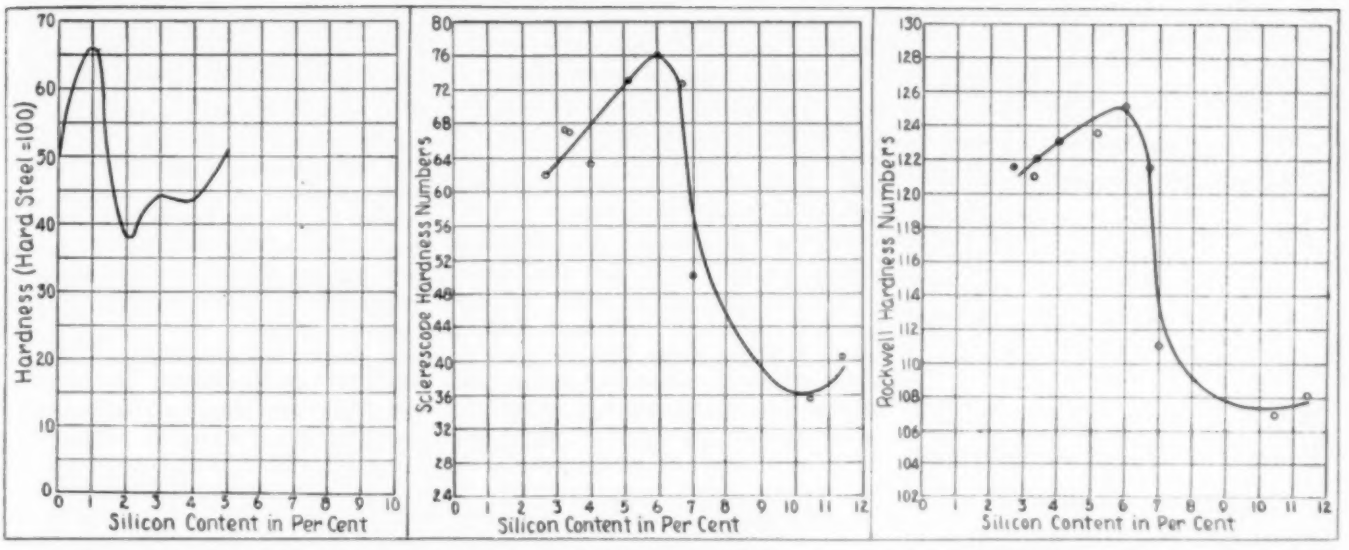

Hardness (Hard Steel =100)
Silicon Content in Per Cent
Sclerescope Hardness Numbers
Silicon Content in Per Cent
Rockwell Hardness Numbers
Silicon Content in Per Cent

FIG. 7—LEFT—HAGUE'S DIAGRAM FOR SILICON AND HARDNESS RELATION. FIG. 8—CENTER—HARDNESS CURVE DETERMINED ON CHILLED SURFACES BY THE SCLEROSCOPE. FIG. 9—RIGHT—RELATION BETWEEN HARDNESS OF CHILLED SURFACES AND SILICON CONTENT DETERMINED BY THE ROCKWELL MACHINE

centrated nitric acid which will attack irons with silicon content up to 19 per cent. In the manganese determination it was necessary to boil the solution to a syrupy consistency and treat with nitric acid to remove the chlorides. This treatment was performed three or four times to effect complete removal of the chlorides and after final treatment with concentrated nitric acid, the solution was diluted and boiled to remove the chlorine in solution.

Determining Manganese

Manganese was determined as permanganate and was oxidized by sodium bismuthate; the permanganate being determined volumetrically with standard ferrous ammonium sulphate and potassium permanganate. Phosphorus was determined by dissolving the precipitated ammonium phosphomolybdate in standard sodium hydroxide and titrating the excess with standard nitric acid. Sulphur was determined gravimetrically and copper and nickel were determined by methods described by the bureau of standards.

Samples for analyses of the standard arbitration bars were taken from the upper end of the bottom half of the broken bars. Samples of incidental bars were taken from the chill bar. All samples were obtained by crushing broken chunks of the metal and screening the material. Particles larger than 0.5 millimeters and not larger than 2 millimeters were used in the analyses.

Transverse tests consisted in applying loads at the middle of the test bar supported at points 12 inches apart. Rate of application of the loads was between 20 and 40 seconds for 0.10-inch deflection in bars with low and medium silicon content and was nearly this in the other bars. All bars did not break in the center, some times due to casting fault and other times for no visible reason. Results of the transverse test are presented in Table II. The shrinkage bars were examined for shrinkage with a steel scale and the amount in 12 inches noted from which the shrinkage factor in Table VI was calculated.

The step bar was ground smooth and clean from sand on the step and opposite surfaces. Several low silicon bars were machine-planed for comparison with the ground surfaces. Brinell tests presented in Table III, were made on the step surfaces as near as possible to the center of each face. Two to five tests were made with a 3000 kilogram load. Rockwell tests also were tried but the ball penetrator seemed too small for consistent results. Chill bars were tested with the sclerescope and the rockwell machines and the results are tabulated in Table IV. At least eight tests were made on each bar and the widely divergent results were rejected as they were not representative of the whole surface as shown by the preponderance of the other results.

Examine Properties

A cursory examination of acid resisting properties also was made by subjecting pieces of the material to the action of acids for a long time under varying conditions. In some cases the particles were small (such as used in analyses) and in others the pieces weighed 75 grams (about 2½ ounces). Deflection of the arbitration bars under maximum load in the transverse tests was determined with an ordinary

Table III

Brinell Hardness of Step Bars

No.	Silicon Per Cent	Thickness in Inches 0.25	0.5	1.0	2.0	3.0
1	2.66	241	228	217	191	211
2	3.29	228	187	159	163	154
3	3.35	241	201	174	166	170
4	4.03	196	179	151	156	149
5	5.16	107	121	143	146	144
6	6.70	.....	170	179	174	183
7	6.01	.....	95	149	156	179
8	7.01	.....	196	183	146	166
9	10.45	.....	.....	131	163	131
10	11.40	.....	.....	170	207	179

Lack of data in some cases was due to failure of material under load applied in making tests.

Table IV

Hardness of Chill Bars

No.	Silicon Per Cent	Sclerescope Hardness	Rockwell Hardness
1	2.66	62	121.5
2	3.29	67.5	121
3	3.35	67	122
4	4.03	63.3	123
5	5.16	73	123.5
6	6.70	72.6	121.5
7	6.01	76.2	125
8	7.01	50.5	111
9	10.45	35.4	107
10	11.40	40.3	108

Rockwell hardness numbers are for the 1/16-inch ball penetrator and a 1000 kilogram load.

Table V

Specific Gravities

No.	Silicon Per Cent	Specific Gravity
1	2.66	6.93
2	3.29	7.36
3	3.35	7.15
4	4.03	7.10
5	5.16	6.74
6	6.70	7.02
7	6.01	6.23
8	7.01	6.95
9	10.45	7.10
10	11.40	6.31

lever measuring device. Apparent specific gravity was determined from the weight of material and its volume. Volume determination was made from the shrinkage bar which had a regular geometric form and was unbroken. This method gave better results for apparent specific gravity than the use of the pyknometer since in using the pyknometer the material was broken up and the water could occupy small holes and pores caused by gases. The use of the pyknometer would give a more nearly correct result for specific gravity than the method used but it seemed desirable to determine the apparent specific gravity in this case. These values are shown in Table V.

Results obtained from the physical tests show a decrease in the transverse strength and flexure with increase in silicon content. A most marked steep drop occurs between bars with 2.69 per cent silicon and those with 6.5 per cent. From 6.5 per cent to 10 per cent silicon the change is rather small and in the last result seems again to be on the increase as shown in Fig. 2. Whether or not this represents the actual trend is in doubt.

A deflection curve drawn from the averages shows a gradual decrease throughout the entire range investigated. This deflection curve is of importance since it gives a clue to the ability of the material of a particular composition to withstand shocks. The curve is shown in Fig. 3. Curves showing the relation between the hardness of the various steps of the step bars exhibit a general tendency to increasing hardness as the section becomes thinner when the silicon content is less than 4.5 per cent. However, from results obtained hardness decreases with decrease in section with silicon content above 4.5 per cent as may be noted in Figs. 4 and 5.

This may be due to the large amount of graphite weakening the metal to such an extent that the bars actually crack under the test pressure, and small cracks not macroscopically noticeable are developed. Credence is given to this account as most of the step bars of high silicon content broke in the thin section when the 3000 kilogram load was applied. Bar No. 5 is different from the sequence of the other bars because the bar is filled with gas holes not noticeable from the outside.

Fig. 6 represents the hardness curves for the 3-inch and 1-inch sections with varying amounts of silicon and seems to indicate a falling off in hardness from the low to high silicon contents. However in the case of the 3-inch section there seems to be a partial recovery at about 5.5 per cent silicon. The curve of the 1-inch section shows a rapid decrease in hardness as the silicon is increased to about 3.5 per cent. Fig. 7 is a curve obtained by Hague, *Engineering*, Dec. 16, 1910, on 1-inch square bars containing up to about 5 per cent silicon. Comparison with the present investigation in general shows variations in agreement. However, Hague obtains the most marked change in hardness between 1 and 2 per cent silicon while in the present experiment the greatest change occurred between 2.5 and 4 per cent silicon. This may be explained that in the present work due to the greater mass of material, including risers and other castings in the same mold, cooling was slower and a different structure resulted.

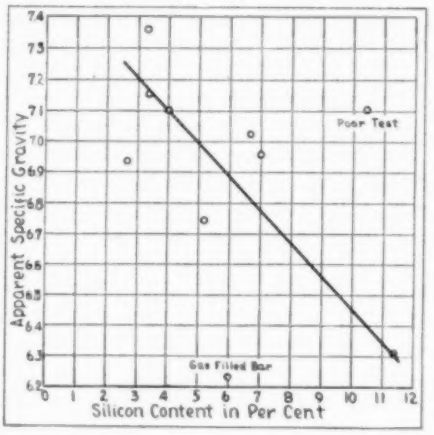


FIG. 10—VARIATION BETWEEN SPECIFIC GRAVITY AND SILICON CONTENT

Test Chill Bars

To further examine the hardness with varying amounts of silicon, an examination of the chill bars was conducted with the scleroscope and rockwell hardness testing machines. The tests were made directly on the chilled surface on the smoothest spots and the results are presented in Figs. 8 and 9. In general these curves exhibit the same tendencies as the others. However, as may be expected from rapid cooling, the silicon was not permitted to exert its full effect on the carbon and the greatest change in hardness occurs between 6 and 7 per cent silicon.

The apparent specific gravity of the metal shows a general decrease with increase of silicon and is due largely to the formation of free carbon. This effect probably is responsible for the change in specific gravity between 3 and 4 per cent silicon. The gradual decrease from about 5 per cent on is due probably to the introduction of the lighter element, silicon. Absolute values of these specific gravities will vary with the manner in which the bars are made, the size of the castings, rate of cooling, etc. However, these tests as shown in Fig. 10 were made in a similar manner and give the tendency.

Examination of the acid resisting properties showed that resistance increased with increase of silicon as might be expected. Relatively small amounts around 5 and 6 per cent silicon greatly changed the resistance to acids of high concentration. A piece of an alloy containing 9.98 per cent silicon and weighing 75 grams was subjected to boiling concentrated and dilute acids for great lengths of time and after being weighed on a rough balance sensitive to 0.1 gram showed no difference in weight. Table VI presents the results of the shrinkage tests and shows that high silicon alloys shrink a little more than ordinary gray irons. Fig. 11 illustrates a condition where the formation of graphite was delayed until after the metal had become cool and in a mushy condition. The sudden formation re-

FIG. 11—COMPLETE RISER WITH CAP OF EXUDED METAL

sulted in an enormous internal pressure which caused some of the metal to liquefy and be forced out on top of the riser. This extruded metal is low in carbon content and different in appearance from the rest of the metal. Fig. 12 shows the riser after it had been broken and exhibits the large pockets of graphite.

From the results obtained the author concludes that the introduction of large amounts of silicon into gray iron decreases its strength greatly. In general the hardness and specific gravity also are decreased with increasing silicon content. However, the hardness is a periodic function of the silicon content and in some cases an increase in silicon causes an increase in hardness. When the silicon additions are not in excess of 10 to 14 per cent, the metal still is strong enough to be useful in many ways.

The greatest change in the physical properties is occasioned by changing all of the carbon to the graphitic form. The addition of large amounts of ferrosilicon to the ladle without previous melting is not wise and such additions will not mix easily with the molten iron.

Selling Is Industry's Greatest Problem

(*Concluded from Page* 53)

castings may find it advisable to maintain a fairly large sales force to compete for the business.

The efforts of the salesman must be backed with advertising of various kinds, such as in the business papers covering the fields in which the castings are used. Wherever possible the management should assist the efforts of the salesmen through cultivation of the customers. After all, much of the sales resistance vanishes with an increase of goodwill.

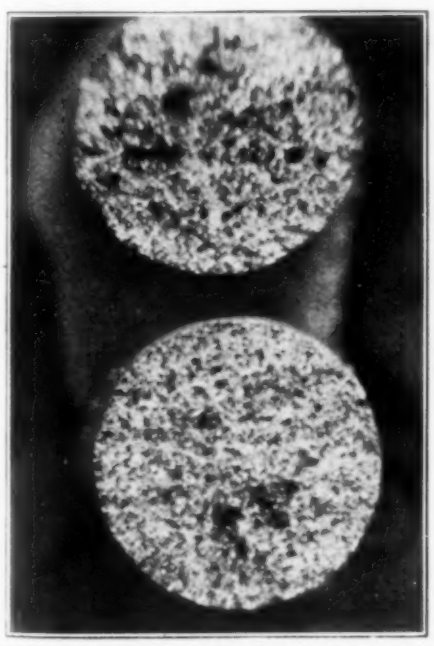


FIG. 12—BROKEN SECTION OF RISER SHOWING CARBON POCKETS

Table VI

Shrinkage Factors

No.	Silicon Per Cent	Shrinkage Factor
1	2.66	0.0104
2	3.29	0.0117
3	3.35	0.0139
4	4.03	0.0139
5	5.16	0.0104
6	6.70	0.0139
7	6.01	0.0139
8	7.01	0.0139
9	10.45	0.0185
10	11.40	0.0139

Factor = Shrink in Distance ÷ Distance

As a result of the faulty cost data and lack of complete co-ordination, price cutting has become a serious evil. The price cutter will attempt to justify his action in several ways. He may point out that it is necessary to cut prices to hold an old customer. Surely this argument should not be taken seriously. If the customer has been satisfied with the quality of the castings supplied and if good service has been given, it should be possible to continue to hold the customer with a fair price. However, if the price is cut below the cost to meet unfair competition, and it is possible to eliminate the competition in this way, will it not be difficult to convince the buyer that he must pay a higher price for the castings immediately after the cut throat competition disappears? It may be advisable to shade prices for old customers, but the minimum selling price always must be above the cost price.

Some foundrymen will cut prices in slack periods to obtain business which they state will help to carry the overhead. Again in this case, the accurate cost figure is absolutely essential, and in no case should any business be taken below the cost of production. Other excuses for cutting prices are to keep newcomers out of the field and to eliminate unfair prices. This line of reasoning may end in disaster for the price cutter. Cutting prices increases rather than eliminates unfair competition.

Foundrymen should strive to produce high quality castings. They should establish a selling price which is fair to the customer and at the same time returns a fair profit on the plant investment. At the same time, service provided should be excellent and this feature should be made a sales argument. If the foundryman will stress the quality, service, price feature in his sales campaigns, the problem of developing a demand of sufficient proportion to require the plant capacity will not be difficult.

Name Chairmen for May Foundrymen's Meeting

Plans are going forward for the thirty-second annual convention of the American Foundrymen's association to be held in Philadelphia May 14-19, 1928. As was noted previously, G. H. Clamer, president and general manager of the Ajax Metal Co., has been made general chairman. Recently the subcommittee chairmen have been chosen as follows: Reception committee—Laird U. Park, Park & Williams Inc., Philadelphia; ladies entertainment committee—Ralph Belleville, Joseph Dixon Crucible Co., Philadelphia; finance committee—C. F. Hopkins, second vice president, Ajax Metal Co., Philadelphia; entertainment committee—Frederick M. Devlin, Philadelphia Hardware & Malleable Iron Works, Philadelphia; transportation committee—Walter L. Kalbach, 12th and Olive streets, Philadelphia; plant visitation committee—B. H. Johnson, Cresson Morris Co., Philadelphia; hotel committee—J. A. Davies, Westinghouse Electric & Mfg. Co., Philadelphia; publicity committee—Earl D. Sparks, secretary, Metal Manufacturers Association of Philadelphia, 1623 Sansom street, Philadelphia.

November Orders Decline

The index of gross orders for foundry equipment in November was 95.8 as compared with 98.0 in October, according to a recent report of the Foundry Equipment Manufacturers association. The index of shipments was 97.2 in November against 113.4 in October. Unfilled orders remained approximately the same, the index figure being 105.8 in November as compared with 106.3 in October. The base is the average monthly shipment for the years 1922-23-24. Comparisons of monthly orders follow:

	1924	1925	1926	1927
Jan.	141.8	104.2	168.2	180.4
Feb.	121.0	108.8	154.9	198.0
March	121.9	159.3	157.3	131.1
April	146.8	124.3	113.2	130.0
May	108.4	113.3	128.5	134.8
June	96.4	110.5	133.5	138.4
July	62.8	117.0	127.3	89.9
Aug.	77.5	190.0	141.2	106.4
Sept.	66.0	94.2	114.0	80.4
Oct.	85.5	149.5	140.5	98.0
Nov.	91.0	180.3	133.4	95.8
Dec.	137.8	140.1	181.0	.....

Base: Average monthly shipments for 1922-23-24.

Driver-Harris Co., Harrison, N. J., has opened a branch office at 7016 Euclid avenue, Cleveland. L. H. Waldrip will be in charge.

How and Why in Brass Founding

By Charles Vickers

Tensile Strength Is High

We are sending a blue print of a casting we must make and wish you to suggest a formula for the same that will have from 75,000 *to* 80,000 *pounds per square inch tensile strength. We prefer to cast in aluminum bronze.*

We suggest the following alloy: Copper, 84.50 per cent; manganese copper, 4 per cent; aluminum, 8.00 per cent; iron 3.50 per cent. The manganese copper need not be iron free, but it should contain 30 per cent manganese. The iron should be in the form of thin sheet free of all solder. This alloy will have between 75,000 and near to 80,000 tensile strength with high elongation, and the latter can be lessened if so desired by increasing the aluminum content to 8.5 per cent. The alloy as given will have the strength mentioned when cast in the shape of massive sections as it is not subject to *self annealing.*

Analyzes Tobin Bronze

We are making a quantity of bolts of tobin bronze. After the castings are made spelter marks show and the bolts break easily when they are hammered. We use a mixture of 58.50 *per cent copper, balance spelter and we are wondering if this is the proper mixture for a forging material. Any suggestions you may have to offer will be appreciated.*

Tobin bronze is a 60-40 brass containing a little tin and some analyses show a trace of aluminum. One analysis of a tobin bronze rolled shaft gave the following results: Copper 60.35 per cent; tin 0.79 per cent; zinc 38.85 per cent aluminum 0.01 per cent.

Such an alloy when remelted and cast into test bars will have a tensile strength of around 52,000 pounds per square inch, with elongation of from 30 to 40 per cent. We suggest the following mixture for the work mentioned: Copper 60.00 per cent; zinc 39.25 per cent; tin 0.75 per cent. To those familiar with the methods of handling the furnace for manganese bronze no difficulty will be experienced in making such an alloy as tobin bronze. However the amateur making the high zinc alloys is likely to experience difficulty securing the necessary elongation. In general it is important to get the two metals of dissimiliar melting points, copper and zinc, thoroughly incorporated and avoid inclusion of oxides; in this case zinc oxide. A small amount of aluminum such as shown by the analysis may be incorporated by first making an alloy of copper with one per cent of aluminum, then adding one per cent of this alloy in place of a like amount of copper. This should be added just when the copper has melted.

Heating Purifies Metal

We desire to obtain a formula for small machinery bearings, and small motor bearings.

The following alloy would be suitable for the bearings mentioned: Copper 77.25 per cent; tin 7.50 per cent; lead 15 per cent; phosphor copper 0.25 per cent. Melt the copper and add the phosphor copper when the copper is nicely liquid, but not hot. After the addition, heat for a few minutes, then add the tin and lastly the lead. Stir thoroughly. Do not be afraid of overheating the metal while it is in the furnace. If it is too hot for the molds when it is removed it can be cooled easily. There should be no specks visible when a fractured surface is examined, but when such do show, the remedy is heat. Before pouring it is advisable to take a test from the furnace, casting a small bar to be broken for fracture examination. In this manner the alloy can be kept to a high standard of quality. For a harder alloy use copper 80 per cent; tin 10 per cent; lead 10 per cent; phosphor copper 0.25 per cent added, or 4 ounces added to the 100 pounds of metal.

Monel Metal Must Be Hot

Can you give us the analysis of monel metal and instructions for melting. Will molding that metal as for brass fill the requirements, and is the shrinkage more or less?

The composition of monel metal varies with the purpose for which it is used. Casting alloys are different to those intended for rolling and drawing. The Navy specifications comprise an alloy of copper 36 per cent; nickel 60 per cent, iron 3.5 per cent; aluminum 0.5 per cent. Another representative alloy consists of copper 28 per cent; nickel 67 per cent; iron 3.5 per cent; manganese 1 per cent, and silicon 0.5 per cent. It is not advisable to attempt to compound the alloy of new materials, and for castings, common monel metal junk is an uncertain material. As the alloy can be bought in ingot form from the principal producer, this is the best way in which to obtain the metal. It will be necessary to use an oil or gas-fired furnace for melting the metal. The metal must be melted quickly and be got hot in the furnace. It can be deoxidized with magnesium to eliminate pinholing, but for this purpose there are proprietary alloys much superior to magnesium.

Molds should be made of a little different sand than that used for brass. The sand mixture often is made by mixing sharp sand with brass molding sand, of the No. 2 grade, and adding a little china clay to aid plasticity. Ordinary brass molding sand will not stand the high temperature at which monel has to be poured. Gate in a manner similar to that used for manganese bronze, and use feeders, and shrink balls to avoid shrinkage draws and cracks. If the foundry is not equipped with oil or gas-fired crucible furnaces, but uses coke-fired natural draft furnaces, it will be an expensive experiment to attempt to make monel castings.

Copper Resists Fumes

We are casting lightning conductor points using an alloy of copper with 5 *per cent each of tin, lead and zinc. However the customers demand a noncorrosive metal as the points are placed on top of a stack and are corroded by the fumes that arise. Can you recommend a suitable alloy?*

If a bronze protector is required use an alloy of copper 88 per cent; tin 10 per cent and zinc 2 per cent. If copper can be used this makes the best lightning conductor. A cast copper rod high in conductivity, cast a little oversize and then reduced and hardened by hammering would make a conductor that would be highly resistant to most chimney fumes.

Foundryman's Genius Builds Architects Vision *in Bronze*

By Gerald K. Geerlings

WHEN one pauses in this bewildering world to consider things like buildings, clients, architects, bronze foundries and their inter-relations, one arrives at a most astounding conclusion concerning bronze. Haphazardly the client and architect may assume that they are bequeathing the building and the "bronzeman" a favor by using the precious metal, but after all is it not merely paying a moral obligation to do so?

Preposterous? Not at all!

Were it not for the first bronze contractor on the job, we, sans our vaunted civilized state, might still be sending international notes on chunks of stone and wearing stone tomahawks instead of carrying automatics. True, we might have lifted ourselves up and out of the Stone Age by means of our sandal thongs into what is darkly hinted at as a possible Copper Age, but if that era ever existed it seems to have sunk with the lost and bemoaned continent of Atlantis. The fact remains that an enterprising soul somewhere in the foggy past decided to combine his gray matter with copper and tin, and *voila*—the Bronze Age started us on the road to Twentieth Century automobiles and radios. Surely no client or architect has ever had a vision equal to that of the initial bronzeman. So again we repeat, since our creditable past dates to the combination of copper and tin to form what we term bronze, that from the theoretical viewpoint of a moral obligation, clients and architects owe the bronze craft a standing order of the material!

THIS description of the processes followed in the foundry pouring bronze castings is abstracted from an article which originally appeared in *Pencil Points*, New York. The article is reproduced through the courtesy of that publication.

The bronze industry seems composed of singularly talented and modest gentlemen. Their forefathers were the actual nucleus of our present-day civilization, yet their sons are not ballyhooed enough for even the architects to be appreciative. The author, as a dyed-in-the-charrette architect, is convinced that the mysteries, worries, abilities and heart-breaking problems of the bronze craftsmen are not given full cognizance by the architects at large. The sentences, punctuation, photographs, diagrams, charts, drawings, etc., which follow are given with the idea of (1) describing how bronze is cast; (2) telling how the architect's drawings and specifications may best secure results for estimating and working purposes; (3) showing good examples of old and new bronze work. It is hoped that stating viewpoints of both architect and artisan may serve a useful purpose, and that the photographs of bronze work may occasionally contribute in the evolution from sketches to details.

The process of bronze casting in the grand old days when the world was youthful was not at all different from the present. There have been muscle-saving devices such as the traveling crane, chain blocks, compressed air, electrical and steam power, etc., but a good casting today is as much dependent upon the human factor as then. Curiously enough, even the composition of the material has undergone no radical departures from the original analysis first used.

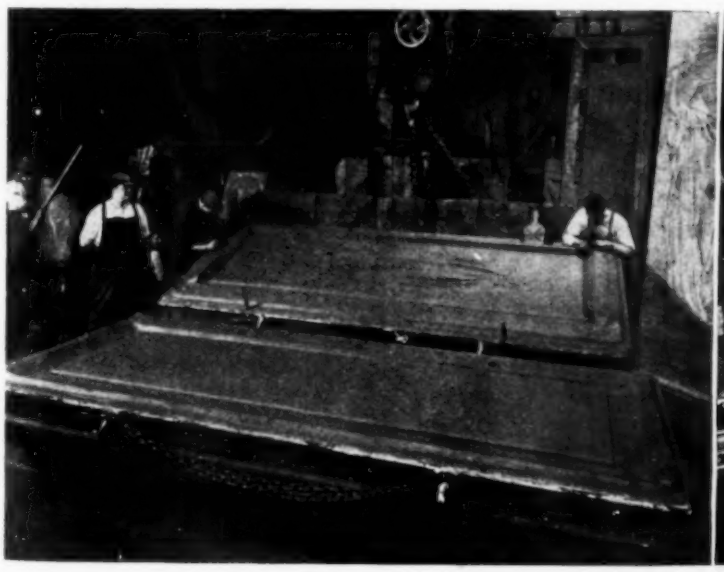


Fig. 1—Preparing the Molds for a Half of an Exterior Door for the Boston Public Library. Fig. 2—Lifting Small Crucibles From the Pit Furnaces

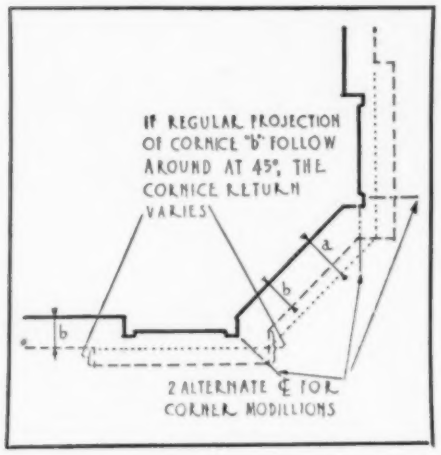


Fig. 3—Drawing Must Contain Complete Information

Bronze Age relics found at the bottom of the Swiss lakes and in certain European caverns, contain 90 per cent copper and 10 per cent tin.

Recent United States government specifications have called for the same proportion of copper, but only 3 per cent of tin and 7 per cent zinc. A permissible change recently substitutes lead for 1 per cent of copper. This, of course, refers to ornamental bronze, such as used for statues, doors, counter-screens, pilasters, and other architectural forms. *Extruded bronze* which has a lower copper content and approaches brass in color, will be considered separately later.

Models Are Made

As far as the architect is concerned the first step in making the casting is for the modeler to prepare his models. When these have been prepared in clay, cast in plaster, and often altered to meet the architect's final approval, they are sent to the bronze foundry as the initial step toward the casting process. At this point it may be in order to suggest that the architect in his modeling specifications make the provision that all models be properly backed so that they will not be damaged at the foundry when the molds are made. It is a good precaution to take, or there may ensue one of those interesting but seldom fruitful wars between modeler and foundry as to who should do the backing. However, assuming that your foundryman is a good-natured fellow, accustomed to swallowing his pride at this game, and accepts the models as they come from the modeler, let us continue our tale.

The preliminary job on which the bronze contractor has been working while the modeler has made merry in clay, is to prepare complete working drawings from the architect's details. As a rule the latter are complete enough where there is straight and easy sailing, but inadequate where there are some tough and dubious corners to turn. "The shop drawings will take care of that," is the architect's slogan too often where acceleration is desired, causing lost time and motion for both the foundry and the architect's office, and eventually demanding that the latter make final decision anyway by working out the difficult spots. For example, the diagram shown in Fig. 3 indicates a problem which might arise on a counter-screen detail. For one thing, unless the modeler took his detail at the corner, there is nothing to give the bronze draftsmen any indication as to what the intersection of ornament is to be.

They can do intersections of the moldings simply enough and would

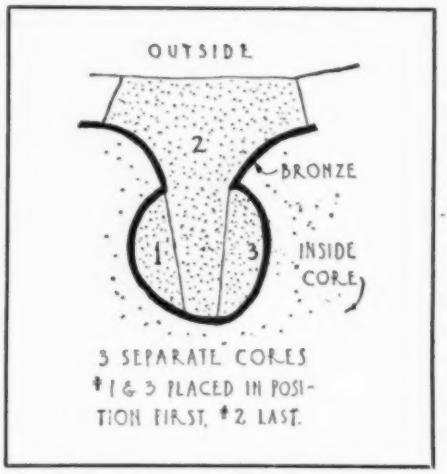


Fig. 4—Cores Nos. 1 and 3 Are Placed in Position First

hardly question that, but unless they know the architect's propensities they will not know whether he will want a dentil overlapping the break on the corner, or prefer to have one on each side; whether he prefers a modillion at right angles to the facia or would rather see the modillion center on the line of intersection. More important still, the bronze draftsmen will have no way of determining whether the projection of the cornice at *a* on the 45 degree corner should be the same as at *b*. If so, it means a greater break in the cornices than was shown on the architect's drawings. This latter condition arises frequently, and after the bronze is erected the architect cannot understand why the bronze contractor did not have the sense to make the same cornice projection all around. After all, even the best bronze contractor makes no claim to clairvoyance and agrees to furnish no mind reading ability.

Assuming that the shop drawings have received their final red checks and rubber stamps, and the models have arrived from the modelers properly backed, the next thing in order is the making of the inside and outside sand cores which, when fitted together in a flask, will allow an empty space into which the molten bronze will be poured. This can be more easily explained by taking a concrete case of the casting of a bust, as diagrammed in Fig. 5. A flask, *A* confines the sculptor's model, *B*, as well as the sand packed inside and outside of it, *D* and *H*.

Cores Are Formed

The point previously taken concerning a model being well backed may be clarified by noticing that if the interior of the head or shoulders were not of a sound thickness, when the sand, *D*, is rammed around it, the model might easily cave in. The highly specialized work at this juncture is the forming of the blocks of sand cores, shown at *D* in Figs. 5 and 6. They must be fitted carefully around the cast in such a manner that they may be lifted out without damage to themselves. Undercutting may necessitate several cores, as indicated in Fig. 4. It takes a steady hand and a long experience to know which cores to build up first and what shape they had best take. The molder employs a variety of attractive spoons, knives and other utensils to steer the sand where it should go, and pack it gently but firmly to form a unified chunk.

At this juncture it is of interest to know that the sand used in cores is no plebeian article. It is most decidedly French, and to a crystal hails from the little village of Fontenay-aux-Roses on the outskirts of Paris. It comes from the one and only pit of its kind and is considered to have no equal. In being used for cores this French sand is packed moist and

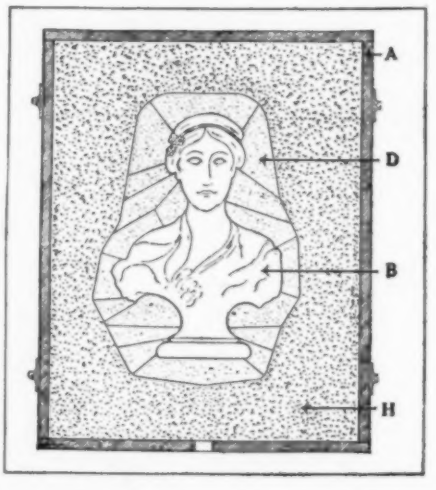


Fig. 5—A Indicates the Flask, B the Sculptor's Plaster Model, D the Separate Cores, and H the Outer Sand Backing

when considered to fit perfectly with its neighbors and the model, is dried out in an oven. When dried or baked its contraction is practically negligible, yet it is so fine that when fingered it seems more like clay than sand. It is so valuable that when its job on one cast is over it is repulverized, sifted, and used over again, but not for facing.

Referring back to Figs. 5 and 6, the next operation on the lady is to give her some brains plus etceteras, indicated by *E*, or, technically speaking, an inner core. The culmination of all the processes is to form a space into which the metal can flow so as to produce a shell about ¼ to ⅜-inch thick, the outside of which will be an exact replica of the sculptor's model. The formation of the aggregate sand blocks already described will form the outer confine for the molten metal, and what remains to be made is an inner core which will be about ¼ to ⅜-inch smaller all around that the sculptor's model.

Makes Duplicate In Sand

This is achieved by making a duplicate of the model in sand, reinforced by supports like the iron bars, *F*, then shaving down the surface equally all over by approximately ¼-inch. In other words a thickness of sand is cut away to correspond to the thickness which the metal will have when poured, shown by *I* (unshaded portion), and then the sand is dried thoroughly. The inner core thus fashioned is suspended in the flask, the outer cores carefully packed around it in their respective places, and the operation is almost advanced to the pouring stage. All that remains is the forming of gates and vents. Both are merely grooves, the former for letting the metal in, and the latter for letting air and gases out. *G* in Fig. 6 represents the feeding channel or gate through which the molten metal will flow. These are made by cutting away the sand before it is baked. The sand surface is painted with black lead to prevent washing of the sand. Smaller grooves as at *C* are cut from the space to be filled with the metal *G*, so that collecting gases and air may escape. The various parts are assembled for a trial fit and then removed, to have themselves dusted of any stray grains of sand by an air blower, and then reassembled in the flask. This latter is securely clamped and the mold is ready to be cast in bronze.

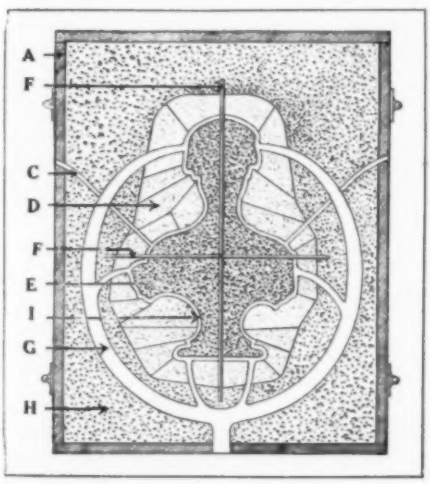


Fig. 6—A Indicates the Flasks, C the Vents in the Mold for the Escape of the Gas, D Separate Cores, E the Inner Sand Core, F the Iron Bars which Support the Inner Sand Core, G Feeding Channels of Gates, H Backing Sand, I Space Between Inner and Outer Core Which Is Filled with Molten Bronze

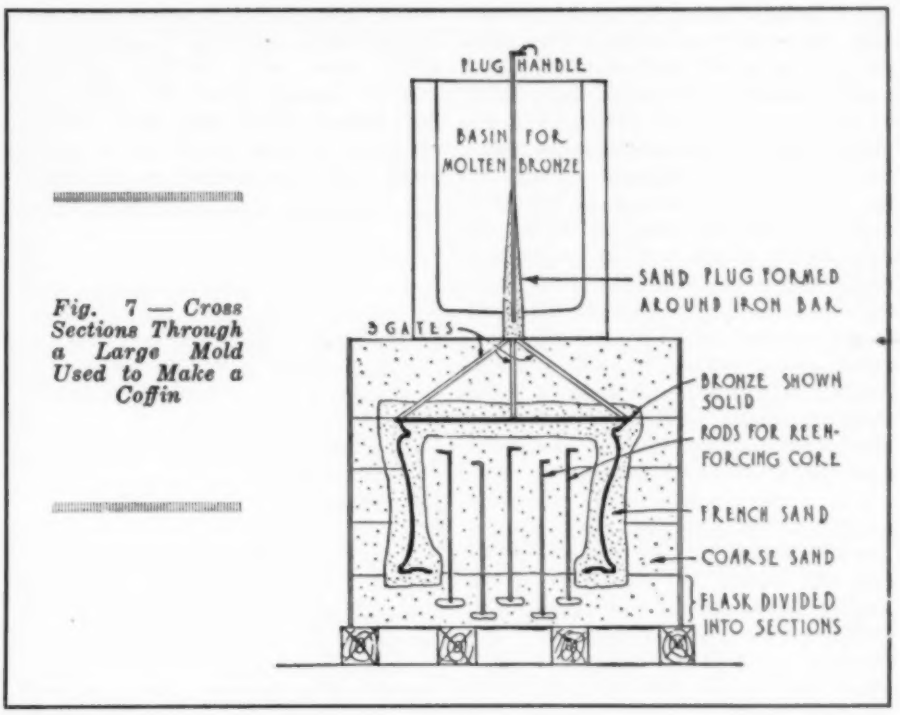


Fig. 7 — Cross Sections Through a Large Mold Used to Make a Coffin

Molds Flat Work

The foregoing description deals with the making of a mold for ornament in heavy relief or statues in bronze which, because of the undercutting, necessitate the mold cores being lifted from the model as described above, instead of the model from the sand. This latter method can be employed for all flat work where there is no undercutting, as in doors, pilasters, cornices, etc. Fig. 1 illustrates this point. Standing upright at the right in the photograph is Daniel Chester French's model for one of the Boston Public Library doors. The imprint seen on the mold in the rear is for the front of the door, while the mold in the foreground shows the reverse side which simply is paneled. In case there is considerable repetition of units to be cast for such architectural forms as door rosettes, counter-screen ornaments, etc., a pattern may be made of wood or metal. In principle these serve the same purpose as the plaster models described, and have cores built around them to form a mold in the same manner.

Another method may be used for casting certain types of undercut bronze. The so-called *cire perdue*, or lost wax process, briefly described is as follows: The surface of the sculptor's model is reproduced in wax; inside and outside this wax shell a composition is poured of the consistency of mud. When this outer and inner composition material is dried thoroughly by heating, the wax which formed the desired surface is melted out and *lost*, hence the name. If a form is to be made as in Fig. 10, it may be seen that instead of making three sand cores, *A*, *B*, and *C* for each identation, that the "lost-wax" process would be simpler to execute. It goes without further comment that for some models one method would be preferable to the other, and that sand cores were described first merely because they follow the older tradition.

Pour From Crucibles

After the molds are completed and are ready to be poured, the exciting part of the show is in order. Crucibles made of graphite, averaging a capacity of about 150 pounds of metal (although there are Goliaths

which hold 700 to 900 pounds), contain the metal ingots which have been put in and heated until they are thoroughly fused. The metal is poured at a temperature of about 1700 degrees Fahr. It is judged to be right by the foundry foreman chiefly by its color. If too red it is too cool, and if white too thin or fluid. If only small molds are to be poured the crucible is lifted by hand from the furnace, as in Fig. 2, while if larger crucibles are in use, mechanical help is resorted to as in Fig. 8. Assuming that a small mold is to be poured two men can prepare the operation under the eye of the foreman, as in Fig. 9.

The workman who made the mold usually is the one to engineer the actual pouring of the molten metal into the form. In Fig. 9 he is the one on the right in the photograph, grasping the two handles, with his helper at the other end as a pivot man. The molder having two handles can direct the metal entering the spout so that it hits the relatively small funnel which opens into the feeding channels of the mold. The foreman's job is to see that the metal being poured is the right fluidity, and with a bent bar to prevent the dross which floats on the top of the molten bronze from flowing into the mold.

Where a mold requires less than one crucible of metal to satisfy its appetite, the job is a three-man affair as described. But in the case of an equestrian statue or a coffin (as a cheerful example), the process is lattered slightly although the same in principle. Fig. 7 illustrates a cross-section through a large coffin about 8 feet long, 2 feet 4 inches wide, and 2 feet deep, ready to be poured. A basin lined with molding sand is erected directly above the mold. At the bottom there are three feeding channels leading to all parts of the mold. At the bottom of the basin

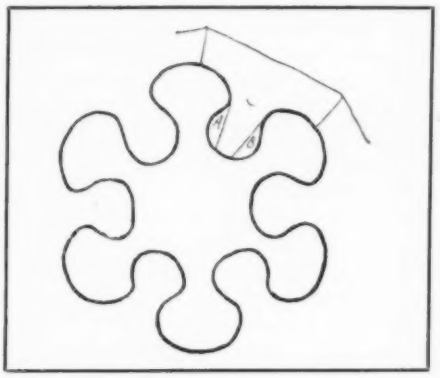


Fig. 10—Difficult Draws Make the Lost Wax Process Desirable

a sand plug formed around a metal rod with one end extending above the top of the basin. Sufficient molten metal then is poured into the basin so that when the sand plug is pulled out the liquid bronze will flood all parts of the mold almost simultaneously. Here again the metal thickness is about ⅜-inch.

When the molten bronze has flooded the mold it takes but a few moments to set and harden. This is because the thickness is only ⅛ to ¼-inch. Perhaps the statement should be made the reverse way. The metal must be relatively thin to allow it to harden quickly. If the metal is poured to form a solid mass or even a thick section, it cools slowly and causes strains and shrinkages which would disturb the surface so that the finished product would not be a facsimile of the original model. To have the metal heavier than a good pouring thickness adds nothing to its strength or durability and is thus an actual liability.

After the metal has cooled the bronze is ready for the cleaning and finishing process. First the flask is opened and as much clinging sand is knocked from the bronze as is possible. The sand has been burned to a terra cotta crispness, and what will not break off is harassed with wire brushes. The inside core is induced to part from the bronze by digging, soaking in water, and further digging. The extraneous parts of the metal which have served as gates and vents must be cut off since they come out of the mold as a unified mass with the actual portion which is wanted. The foreign residue remaining after the wire brush treatment, as well as heat discoloration, are lost by dipping the entire bronze mass in an acid bath for a brief interval, then washing off the acid in hot water before it has had a chance to etch the surface. The chasing part of the game comes next when all excrescences and fins are removed by saws, files, etc. Ornament is then strengthened and cleaned with mats, tracers, riffles and files.

The matter of how much work should be done on cast or wrought bronze at this point is a subject of some controversy, some exponents maintaining that it is not a craftsmanlike job unless the tool marks are in evidence. This is a matter for the designer to decide. The architect or designer may have a certain ef-

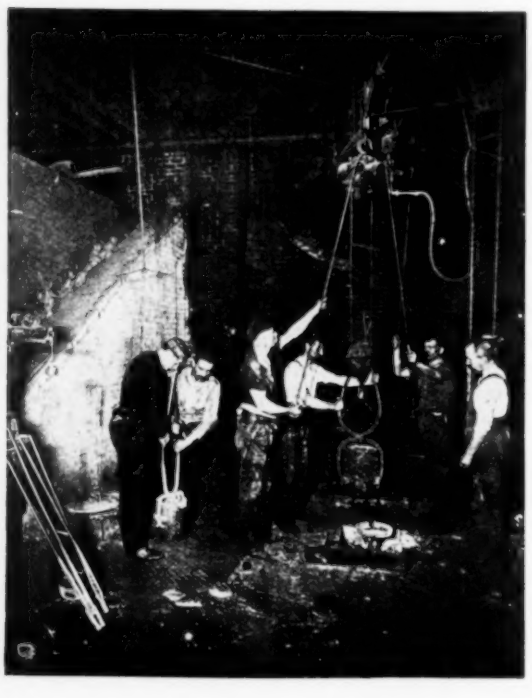


Fig. 8—Mechanical Equipment Is Used to Lift Large Crucibles From the Furnace

Fig. 9—The Molten Bronze Is Poured from the Crucible into the Mold

fect in mind or a certain texture which he believes can be achieved only by tooling the metal.

Subsequent to the chasing and filing comes the fitting together of various parts, as in the case for a counter-screen. When parts are to be joined together at certain junctures it is termed brazing, a matter of applying a blow torch until the metal becomes sufficiently hot to fuse with a special alloy acting as solder. Sections also may be screwed or bolted together.

Finishing, polishing, and coloring operations follow the fitting. Samples are submitted to the architect for his selection of finish. Various agents are employed in attaining whatever surface and finish are desired. There is some latitude in both of these, but not as compared to the color. The actual color of bronze is bright and shiny, like a new penny before being handled, and is never anything else. Almost any color may be obtained by various oxidizing agents, but it should be remembered that these various colors are due to the chemical change which takes place after some agent is applied. The bronze craftsman can achieve almost any color with patience and chemicals. Chloride of ammonia as well as common salt and vinegar will react to produce beautiful greens, while various browns can be coaxed with the application of sulphide of potassium.

Treating the surface of bronze in one way or another to give a desired color, affects the surface only, and on scratching the surface with any sharp point the bright metal will shine through. There is no action comparable to rust on iron which eats away the material. Oxidation or weathering will effect the surface of bronze to perhaps a millimeter in depth but will go no further, thus accounting for the attribute of being the *eternal metal.*

Presents Conception on Graphite Formation

In commenting on J. W. Bolton's paper, "Some Graphite Formations in Cast Iron," presented at the American Foundrymen's convention at Chicago, and published in the Oct. 1 issue of THE FOUNDRY, Prof. E. Piwowarsky, Aachen, Germany, commends the effort to establish order in the chaotic nomenclature of graphite formations. He also states: "One point which appears to me as somewhat premature is the (apparent) denial of the possibility of direct graphite crystallization. I do not agree that under ordinary conditions prevailing in foundry practice, precipitation ordinarily will take place with the preformation of carbide.

"However, the work cannot be regarded as complete until some attention is vouchsafed the possibility of direct crystallization of graphite. At the present time it is difficult to form an accurate conception of the atomic mechanism involved in certain phases of graphitization. Recent research shows that in certain silicon-rich irons the majority of carbide carbon remains dissolved supersaturated.

"One may conceive that at the temperature corresponding to the beginning of graphitization, the mass action law may be applied as follows:

$$\frac{Fe_3C}{(Fe)^3\ (C)} = K$$

Therefore, equilibrium can be destroyed through the crystallization of elementary (that is, graphite) carbon as is apparent from the equation:

$$Fe_3 = 3\ Fe + C$$

Reaction in the liquid proceeds to the right since one phase (graphite) is removed from the system. It is not known whether this is an exact conception of the real mechanism. However, the writer believes that such a possibility should be given consideration."

Replies to Comments

In replying to the accompanying comments of Professor Piwowarsky on his paper, J. W. Bolton states, "As Professor Piwowarsky says, practically all irons do follow the mechanisms indicated in the paper. He feels that it cannot be considered a complete summary of the whole subject unless the apparently rare phenomena of complete direct graphitization from austenite be given consideration.

"That is true enough. The paper covers reactions occurring in the vast bulk of commercial irons. Others, at present most interesting from an academic viewpoint, have been the source of argument for many years. The question is the old one of the double equilibrium diagram. While we did not give any evidence on direct precipitated graphite formations (having none and not having heard of anyone accurately identifying such formation as distinct from those shown), we specifically avoid a denial of the possibility or probability of direct precipitation.

"Professor Piwowarsky's attention is called to the use of the term *potentially pre-existent* cementite. This term was used advisedly to cover the point commented upon. The writer is of the opinion that when finally worked out, the identities in the paper will remain as listed, and we merely will retain the term potentially pre-existent or use the term pre-existent.

"Professor Piwowarsky's use of the dissociation constant and reversible equilibria seemed to be based on the kinetic viewpoint. Perhaps further elucidation from the thermodynamic point of view including entropy would prove profitable. Hypothetical considerations demand existence of free (atomic) graphite even within the liquidus. In this connection Professor Hanson, Birmingham, England, has written a paper dealing with equilibria of carbon, iron and silicon."

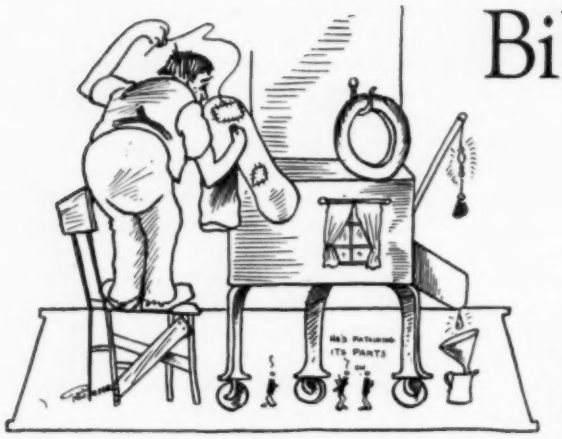
Organize Short Course

The program committee of the American Foundrymen's association is planning to organize a short course in cupola operation to be held in connection with the Philadelphia convention. The plan as outlined is to have four two-hour periods of the convention week devoted to the study of problems of cupola practice. Men well-qualified to lead in the discussion will be selected, and the first half-hour of each period will be devoted to talks by these leaders. Following the talks, opportunity will be given those in attendance to relate examples of troubles time will be devoted to discussions of how thse particular problems have been overcome in other foundries. The meetings will be held on May 15, 16, 17 and 18. The program committee would like to receive suggestions from any desiring to attend this course as to points of cupola practice that they would like discussed.

Compares Two Methods

A number of tests on malleable iron produced by the American and European processes in Russian foundries are presented in a bulletin published by the mechanical laboratorium of the Politechnicum, Kiev, Russia. The tests were made by S. S. Nekryty under the supervision of Prof. K. K. Siminski. The tests show the superiority of the specimens of blackheart or American process over the European or whiteheart process. The author also states that the European method of annealing requires more fuel and that the cost per ton for production of blackheart malleable is less. The greater part of the text is in Russian with a resume in English.

Harnischfeger Corp., Milwaukee, has established a branch office at 340 Rockefeller building, Cleveland, in charge of J. T. Conners, district manager.



Bill Hears from One of the Musketeers

By Pat Dwyer

AT ONE time or another either, in the role of employe or visitor I have seen the inside of—well let us say—a considerable number of establishments where metal is melted and poured into molds. A strict regard for the beautiful virtue of truth compels me to admit that my status on these occasions has biased my vision to a certain extent. Nothing remarkable in that, sez you. The horse tethered to a picket rope has a different point of view from the free ranger coursing over the open plain with his mane streaming in the wind and with his tail cocked at an eloquent and derisive angle to the flying horizon.

I have seen big shops and little ones, old rookeries and others perfectly appointed in every respect; shops in which it was a pleasure to work and shops known far and wide in the colorful vernacular of the touring gentry as *slaughter houses*. Some places presided over by sincere, honest and highly capable men who knew what constituted a day's work and never experienced any trouble in getting it out of their men. I have known other places where the big *I* was a combined personification of Judas Iscariot, Simon Legree, a cock eyed Texas mule and a dyspeptic crocodile. Hard words, me hearties and you may lay to that. All the bucko mates do not sail the high seas with a belaying pin in each hairy fist. Probably the worst fate of these sea going gentry is that eventually they will fall overboard and be gnawed into small pieces by a flock of alert and toothy sharks. That is only a pleasant path to paradise compared to the fate awaiting their prototypes on land if some of their admirer's prayers are answered.

However, that has nothing to do with what I had in mind when I sat down in front of this dainty sheet of blank paper.

"Oh" you say in well simulated surprise "so you had something in mind, hey?"

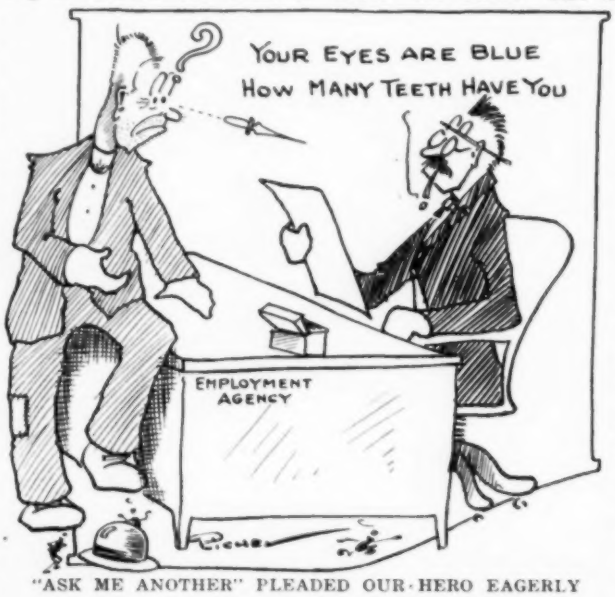
Certainly I had something in mind. You don't mean to say that you suspected, actually suspected mind you, that I deliberately would lead you on this distance unless I had a burning message to deliver. Do you think unless I had some thing to say I should go to the bother of oiling up this little machine and inserting a sheet of paper? Try it yourself some day and see how far you will go. Sit in front of the machine with a blank mind and watch the neatly typed sheets roll out by themselves. You will be surprised!

Enough of this idle persiflage. Let us get on with the work. Life is real, life is earnest and—er—so forth, if you take my meaning.

One of Mr. Kipling's most widely quoted lines is: *East is east and west is west and never the twain shall meet.* Far be it from me to take issue with that sterling bard who usually displays the most amazing skill in tapping the well known nail directly on the head, but in the present instance I think his poetic fervor led him to cover too much territory and to spread himself over too great a period of time. Never is a fairly strong word. A word to be held in reserve, to be handled cautiously and only to be used after due care and deliberation. After a proper survey of the situation has demonstrated to the satisfaction of all parties concerned that no other word will serve.

A short time ago I visited two foundries in a mid-west city doing business within a short walk of each other and yet as far apart in nearly every respect as East and West. One represented absolutely the last word in building construction, mechanical equipment and scientific methods. A large force of raw and semi-skilled labor was turning out several hundred tons of highly intricate castings every day.

The other shop was erected about 70 years ago and the crooked walls and drooping roof had been propped up here and there many times since, in a gallant effort to prevent them from collapsing like an empty barrel when the head and hoops are removed. Some day a high wind or a heavy fall of snow will summarise it as effectually as the colored plowman in one of Irv Cobb's radio stories, who was struck with a lightning bolt and reduced to the general size and condition of a half burned potato cooked by an amateur in a camp fire.



"ASK ME ANOTHER" PLEADED OUR HERO EAGERLY

Mechanical equipment is represented by a small, hand-operated, jib crane that squeals in protest and leans drunkenly from the perpendicular each time it is burdened with a load. The cupola is a converted boiler shell about 30 inches in diameter set up on four short legs so that the shank ladles may be filled while sitting on the floor in front of the spout. A pit is dug in front of the furnace to accommodate the 1-ton ladle when metal is required for a really massive casting.

Blast from the fan is conducted through an 8-inch pipe

to a point a few feet back of the cupola. Here the pipe is divided into two curved branches that enter the furnace at two diametrically opposite points about 10 inches above the bottom. The curved metal pipes long since have disappeared and their places have been taken by two sections of canvas pipe with iron nozzles leading into the tuyere openings. Trifling repairs to the canvas pipe are effected by the application of small patches of canvas wrapped firmly in place with hay wire. It is the essence of simplicity with no tiresome waits for a millwright or tinsmith. It is not even necessary to shut off the wind.

Immediately after she pops, the old cupola man shouts the most dreadful imprecation, one coined specifically for the purpose and one which has been polished, pointed and sharpened over a period of many years to a high state of perfection. Then he grabs a canvas patch and a coil of wire and proceeds to repair the damage to a running commentary of the most blistering invective on all inanimate objects in general and canvas pipes in particular. He pulls each strand up with a vicious jerk and I imagine derives a certain amount of pleasure from the fancy that he is applying a garrotte.

The cupola is located near the middle of the foundry instead of in the usual position close to one of the walls either inside or outside the building. It is surrounded by a charging platform about 8 feet above the floor. A square brick stack forms a continuation of the cupola from the top of the old boiler to a point a few feet above the roof where it leans over at a more alarming angle than that of the famous tower of Pisa. Through some mysterious influence everything about the place seems to be immune to the law of gravity.

Perhaps I should make one exception. They were running off a heat the day I was in, and I noted that the iron comes down through the stack and flows out through the spout in the ordinary manner.

Some of the wood flasks are comparatively new, dating back probably no later than the rushing war years 1914-1918, but I saw a few hoary old veterans which I am sure must have been used by the gallant lads who dropped their tools in response to Lincoln's call for men to save the Union. Ask grandpa some time if he can remember seeing the long lines march away under the fluttering banners behind the blaring bands and the booming war drums—never to return.

Several generations of molders have used these flasks since that time but how they ever manage to keep the sand in some of these rickety old copes is beyond my comprehension. I believe St. Paul is credited with the statement that faith will move mountains, but I am afraid the faith of that doughty champion would have failed if he had been asked to guarantee a good lift with one of these

SPORT TERM: GIVING THE DOGS A WORKOUT

venerable copes. If my memory serves me right he also introduced a saving clause to the effect that faith without good works is dead.

Most of the men were elderly and naturally I assumed that they were fixtures. I picked out one at random and as an excuse for starting a conversation I asked him how was business. He skillfully dropped just the right amount of tobacco juice on a corner he was patching and inquired with a down east accent if I was looking for a job. I could have pointed out to him quite logically that he had not answered my question, but what's the use of splitting hairs? Also from former association I knew he was only acting in accordance with his early training. I told him quite truthfully that I had a fair to middling job in another town. I just happened to be passing through and I was interested in the state of trade.

"Well, podner," he said, "I'll tell ye. Business ain't none too good, but if she'll hold out till Sat'day night I ain't kickin'. I aim to blow out of this dump about that time."

"Friend" I said "you astonish me. Pray forgive a natural mistake. I thought you were a home guard. Seeing you in this place and in this company I fell into the error of assuming that you were born in this town and that man and boy you had worked here at least 40 years."

"The hell you did!" remarked this noble exponent of the ancient and honorable art of casting in metals. "Forty years in this rat hole of perdition? I've only been here a week and that's a week too long."

He was an exceedingly profane person and I have no intention of sullying this virgin page with a verbatim report of his conversation. Many years association with the foundry industry has rendered me immune and practically shock proof, but I must confess some of the terms in his extensive vocabulary caused me to shudder involuntarily. Later I was relieved greatly to find that he had enjoyed a post graduate course outside the foundry. His accent led me to ask him if he ever had worked in a certain New England foundry.

"Did I?" said he "Say fella, I served my time there with old Joe Jackson. Was you ever down that way?"

I modestly admitted that at one time I had circulated kind of promiscuously in that general section. Though we never had met, we found that we had quite a number of mutual acquaintances. Also at one time or another like the well known ships that pass in the night, our paths had crossed in various parts of the country.

"The good old days is gone" he lamented "and the good old boys is gone with 'em. I don't hardly ever run into 'em any more. The shops is filled with machines that does everything but ask for a raise. They don't need no molders any more. When I blows in here a little over a week ago I goes over to the big new shop and asts for a job. I intended to walk into the shop and see the main gink, but was stopped by a bird with a cop's uniform who looked as if he wished he could find some excuse to pinch me. His job was to keep people out. He swelled up like a turkey cock when I ast him who I should see about a job. 'I ain't no guide' ses the big bum. 'On your way. Beat it.' " I'd like to take a poke at that guy before I leave town.

"Finally I gets around to the employment office and a fella asts me

a lot of trick questions to see if I was a molder or a dromedary. Some of them was right hard, like is a cope the top or the bottom of a flast and what is a double ender. Then he gets out a sheet of paper and marks down my age, nationality, height, weight, color of eyes and hair, number of teeth (if any) and about 100 other items which had about as much to do with the foundry as the color of my saintly aunt Jemima's hair has to do with the output of duck eggs in Squash Center, Vermont.

"Down near the bottom of the page he found a place to ast me for the names of at least three places I had worked, why I had left and had I any recommendations.

"I figgered I might just as well give him the whole works. I told him I had never worked in only one shop, a place run by my uncle Tim in Scituate. I give him this Scituate place on purpose to see if he could spell it. He couldn't. I said we had an old fashioned cupola without no hood over the top and one day one of the boys built too big a fire in it. The iron boiled over and set the shop on fire. My uncle lost his life trying to save the time clock and therefore I had no one to give me a recommendation. The bimbo at the desk admitted it was a remarkable occurrence—made a note to bring it up at the next safety first meeting—and then told me to report for work in Building 71, Aisle 4, Section 12 the following morning.

"What do you suppose they give me to do? Me that has worked in green sand, dry sand and loom under the hook in some of the best shops in the country? I hope to die and be hung head down forever inside one of the roaring cubelows of the bad place if I wasn't set shifting weights on a procession of little dinky molds passing by on a conveyor!

"I stood it for a coupla days and then come down here. Its a fierce joint, but I guess I can stand it until the end of the week. The class of work ain't in my line, but at least I am allowed to handle the tools and make a mold from beginning to end. I don't need no fresh young guy with a stop watch in one hand and a slide rule in the other telling me the exact distance to lift a rammer, how many times to give her the pein and the butt and where to stick the gate pin. I was doing them things before he knew whether to wipe his nose or let nature take its well-known and customary course."

Although I knew fairly well in advance what his answer would be I inquired politely which direction he intended to jump when he shook the dust of the town off his feet.

"What's the difference?' he remarked carelessly. 'I ain't particular. East, west or south, its all the same. However, I'll let you in on one little golden secret, I ain't going no farther north, not at this time of the year. The first train I can ketch going out of here is good enough for me. If things breaks right I'll drift down through

ONE WAY TO HANG UP A RECORD

Cleveland, Pittsburgh and Wheeling. There's a few good shops left in those places yet. Before real cold weather hits in I'll be down around the Gulf coast and that's far enough to figure, for now."

I asked him if he knew Bill.

"Know him?" he cried in surprise. "I'll tell the world and his first cousin! Why me and him and Jack Haverty and Martin Skelly bummed all around the South one winter from Pine Bluff, Arkansaw to Birmingham. There wasn't no brass band to meet us in N'yawleans and the foundries wasn't taking on no men, so we gets a job for a week with a gang on a tramp steamer unloading a general cargo. Work! work ain't no name for it. Some of them barrels and boxes must have weighed a ton, and I don't mean maybe. Well, so long. I may see you later. When you see Bill give him the good word. Tell him there is still a few of us left."

Later when I met Bill I told him of the incident and asked him if he remembered the lad and the southern pilgrimage.

"He did not tell you half of it" said Bill. "Especially the night life in certain parts of the old Creole city. Tommy was a gay blade in those days and could roll the bones with the best of them. In fact for a limited period his skill in this respect was all that kept us from raiding the garbage cans to keep body and soul together. We were healthy and happy and as what's-his-name, Kipling says, we took our fun where we found it. Haverty, who came from a nice home in Rochester was an accomplished pianist and had some experience on the vaudeville stage. He was a mimic, a whistler and I never have seen a better buck and wing dancer. I could shake the old dogs myself in a fairly creditable manner in those days and the bar tenders in the various places—gentlemen every one of 'em—appreciated our efforts and behaved right handsomely.

"Martin was not much of a shining light socially. His idea of a good time was a rough and tumble fight, heel and toe, no holds barred and with perfect liberty to use every member with which he had been endowed by nature. Under ordinary circumstances he was a quiet and peaceable lad who minded his own business, a strong, hard boy with several boxing records to his credit. A few drinks transformed him into a ruffling bravo with an intense desire to beat some person, any person, into a hunk of dog meat. A bad actor at time.

He hardly ever lost a casting and as time went on he acquired the viewpoint of professionals in every line. He felt he had a reputation to sustain. On that trip Tommy was telling you about, the four of us got jobs in different shops in Birmingham. Much against his will and inclination Martin accepted a side floor position and acquitted himself quite creditably for several days. Then he was given a queer little tricky pattern and lost three castings in succession. When he shook out the third casting and found it was a waster like the others, he grabbed the pattern, a hammer and a long spike and climbed up among the beams supporting the roof of the shop and nailed the pattern in a particularly dark corner."

"What was the grand idea?"

"That's what I wanted to know" Bill replied "when he told me. He said if he couldn't make the casting he was going to fix things so no other molder could come along and brag he had made it!"

Cupola Operation Requires Skill

Practical Foundryman Gives Information Gained By Actual Contact During a 20-Year Period on Preparing and Operating a Foundry Cupola

COMMENCING with a new cupola or with one which has been stripped, the shell first is plastered for a short distance with a ⅜-inch thickness of daubing material. This is followed with a course of fire brick, dipped in clay wash, stood on end and laid flat against the daubing. After the first row is completed, thin clay wash is poured over the top to fill all the crevices. Succeeding courses are built in the same way with the joints broken in the customary manner. If necessary at any time to reduce the diameter of the cupola a second or even a third wall of brick may be laid before setting the cupola blocks which constitute the lining proper.

Blocks should be laid carefully, accurately and closely. They should not be dipped, but it is advisable to spill thin claywash over the joints after each course is completed. The tuyeres usually are placed 16 to 20 inches, that is four or five rows above the bottom plate. The upper row of blocks is covered with a ½-inch thickness of daubing to form a tight seat for the tuyeres. A continuous type tuyere gives the best results. A tuyere 6 inches high is suitable for cupolas of all diameters over 36 inches. Wide tuyeres require a center post and care must be observed to keep the windbox end open. After the tuyeres have been adjusted in place the brick and block linings are continued upward. A wood fire with a small amount of coke is built inside the cupola to dry the lining before the cupola actually is prepared for a heat.

Some melters prefer a straight lining in a cupola while others, including the writer, favor the bosh form of construction. Prejudice against bosh lining in some instances is based upon unfortunate experience where the bosh feature was not constructed properly.

For a bosh lining on a 36-inch diameter cupola, the first row of 4-inch blocks above the tuyeres should be set to the regular diameter, 36 inches. The second and third rows should overlap to form a 30-inch ring. They are backed by a square and a flat brick, stood on end, face out. The fourth row should be set to a 32-inch circle and backed by half square brick stood on end. The fifth row at 34 inches is backed by half split brick. The sixth row is set at 36 inches, the normal diameter of the shaft and succeeding rows up to the charging door sill. The steps on the rings immediately above the tuyeres are filled with daubing material and smoothed with a trowel to present a gradual incline.

On larger cupolas the baffle ring is raised and made wider. For example on a 54-inch cupola the projection may spring from a point 8 inches above the top of the tuyeres and extend in to form a 42-inch circle.

Not All Alike

Some operators claim that the baffle ring should be located at the same height and extend the same distance from the wall in all cupolas. This contention has been disproved on many occasions. By a little observation and judgment the cupola man easily can adjust the baffle plate to secure maximum service. When an increase in melting speed and temperature is noted, then the baffle ring in use on that day is retained on the following day and also thereafter indefinitely until a change in conditions may cause a revision in the position. A height of 8 inches is sufficient for any cupola and a width of 6 inches usually is all that is required. I have had ideal melting conditions in an 84-inch cupola in which the baffle ring was restricted to 72 inches.

Making up the breast is one of the most important features in cupola operation. Several methods are practiced. In one that has given perfect satisfaction the tap hole is made the full depth of the lining with the outside formed by a square brick containing a 1-inch hole in the center. This hole may be drilled on the job or a special block ordered from any of the foundry supply houses may be employed for the purpose. The tap hole is located at a point that will drain the cupola and may range from 4 inches in a small cupola to 8 inches in a large cupola, above the bottom doors.

For security the breast block is placed in an opening in the brick lining and fastened with wedges before the clearance is daubed with mud. A damp mixture of fire clay, molding sand and crushed fire brick is rammed behind the brick. A 1-inch pipe or bar may be set in place before the material is rammed back of the brick, or, a steel pin may be driven through afterward to form the tap hole. In either case the opening is flared after the pipe or bar has been withdrawn and the breast is dried inside and outside. The tap hole is left open until after the cupola has been charged. It is packed with molding sand or plugged with a piece of 1-inch core before the blower is started. This breast and tap hole may be used for several days without any renewal except a little filing and chipping. The spout should be bricked and present a channel tapered down to about 2 inches. It will last for a long period.

Trouble with the slag hole freezing or blowing out is experienced in many foundries. Some melters favor the practice of opening and plugging the slag hole at regular intervals. Except under exceptional conditions the practice is not recommended.

A slag hole should be located at least 2 inches below the tuyeres, with a 45 degree drop from the inside to the outside. A hole 4 inches square is left in the brick lining and is packed full of the same mixture employed in the breast, 2 parts fire clay, 2 parts molding sand and 1 part ground brick. A tapered plug is rammed in place or a tapered steel bar is driven through to form the slag hole.

In some instances it may be necessary to build a small fire or use a torch to dry the packing around the slag hole, but usually the flame that is driven through after the blast goes on is sufficient.

The mixture referred to previously, 2 parts fire clay, 2 parts molding sand and 1 part ground brick, with the addition of a little water, has given excellent satisfaction as a daubing material. It is prepared in a mixer of the muller type and then wet down and allowed to stand all day or over night in a box provided for the purpose. Where the cupola is prepared at night, it may be advisable to have two boxes from which the daubing material is taken alternately.

With the foregoing practice, even under severe melting conditions and

with long heats, the cupola lining should last 6 months. Then by tearing out and replacing not more than 14 rows of blocks, the cupola is as good as new. After the burned brickwork has been removed the area is washed down clean with a hose to remove all slag, shot and ashes. The diameter, shape and size of the bosh are kept on record and in all repair and patching these dimensions are maintained as closely as possible.

In a patching job the area first is covered with daubing material into which the brick is bedded securely. The first course of brick is started on the edge of the baffle plate to get the circle true and the proper diameter. The brick is laid sideways. In this position it will stand rougher usage and will not get broken so easily by the load constantly slipping past. Inequalities are filled with thick mud. The face is smoothed with a trowel and brushed with clay wash. The face of the lining below the tuyeres is given a coating of clay wash.

Sometimes the question arises if it would not be better to reline the melting zone instead of using so many bricks every day patching it. No definite rule has been established, but in several prominent plants the custom of using bricks to patch the cupola is continued so long as the number does not exceed 10 for every ton of iron melted during the heat.

Sand For Bottom

A little daubing on the edges of the bottom doors before they are propped into position will insure a tight fit and prevent a possible leak. A small amount of fine coke or cinders over the center part of the door will facilitate the escape of steam and gas from the sand bottom. Sand for this purpose should be just damp enough to hold together when it is rammed. Old, coarse sand, with all the organic material burned out of it is best. New sand, hard sand or wet sand will cause the first iron that comes down to bubble and freeze in the tap hole. The sand is spread over the bottom doors approximately level, then it is tramped and rammed with the butt of a rammer, quite firmly around the edge and not quite so hard in the center. A pin inserted in the tap hole serves for a guide in determining the finished depth of the sand bottom. The sand is manipulated with a short straightedge until the surface in all directions slopes away gradually from the tap hole. A slant of 1 inch to the foot is sufficient to drain the cupola.

If a torch is employed to light the fire, the coke may be charged directly on the sand bottom. If wood kindlings are used, the bottom first is covered with shavings and then wood is placed on the shavings, small pieces first horizontally and afterward longer pieces laid up against the lining. The wood is placed by hand and incidentally protects the patched lining when the coke is forked in from above. About two-thirds of the bed coke is placed before fire is lighted. After this has burned through additional coke is added to level it up. Just before charging time the remainder of the coke is added to bring the bed to the desired height. The tap hole and tuyeres then are closed so that the bed will not burn unduly during the charging period.

Charging the Cupola

For cupolas running long or fairly long heats, 2 hours or over, limestone in the proportion of 60 pounds per ton of iron charged, is an absolute necessity in keeping the inside of the cupola clean. Some melters commence with the third or fourth charge, but for long heats it is advisable to use limestone on every charge including the first where the limestone is placed on the center of the bed coke. Steel (if needed) also is charged on the center followed by pig iron around the edge. The charge is leveled with scrap with the large pieces in the center. Manner in which the iron is charged is reflected in the condition in which it comes from the spout. Uniform charging will yield a uniform product. Only good, clean coke should be used in the cupola, from 270 to 300 pounds per ton of iron. An extra forkful on every third charge will hold the bed up on a long heat. A low bed will give cold metal.

Cupolas almost invariably bridge to some extent above the tuyeres. On long heats it is necessary to break this bridge occasionally by poking a long bar in through the tuyeres. The bridge is formed by cold air coming into contact with the descending molten slag. Eventually some of the iron also is caught and either freezes on the bridge or trickles into the tuyeres and thence to the windbox. This condition retards melting, cools the iron and gives the cupola tender a great deal of extra work on the following day clearing away the mess. Where the bridging is not uniform the blast is diverted and the lining of the cupola is unduly cut in some places.

A heavy bridge will result in thick, viscous slag and cold iron. The cupola tender's object is the production of a thin fluid slag that will flow readily through the slag hole. However, this can be overdone and the evidence is a white slag. Slag wool floating in the vicinity of the back of the cupola is an unfailing evidence that the slag is flowing properly.

Light steel scrap, flashings, etc. is not satisfactory material for charging into a cupola. The same applies to rusty, painted structural steel. Steel scrap in the form of short rails is the most satisfactory. After that comes shafting and bars. The cupola should not be loaded above the charging door sill.

Spain Completes Plans for Convention

A formal invitation has been issued by Union Industrial Metalurgica, Barcelona, Spain, to all technical foundry associations to attend the foundry congress in Barcelona, Spain, in April, 1928, as was announced in THE FOUNDRY, Dec. 15, 1927.

The final program is not yet available, but the event will include the congress itself, which will be held in Barcelona, and will be followed by a tour of inspection in the industrial districts of Spain. A number of the leading founders and manufacturers of Spain have expressed their willingness to open their doors to visitors.

The congress in Barcelona will last four days, during which time visits will be made to the Hispano-Suiza automobile plant, the manufacturers of water and gas meters, Founderie Grau for cast iron, bronze, brass and aluminum, the iron foundry of Mas y Baga and the steel foundry of Escorsa, the Sert foundry and the school of industry. The first day of the inspection tour will be devoted to a visit to the iron and steel plant of Sagunto; this plant recently has been completed and has been erected on modern lines. At Cordua the electro-metallurgic plant of Penarroya will be visited. At Seville an inspection will be made of the Pirotecnia Militar works and ordnance works. There will also be a visit to the Spanish-American exhibition which will be held at that time in the city. At Toledo a visit will be paid to the arms factory of Toledo. At Madrid the works of the Madrid-Zaragoza-Alicante railroad and the central laboratory of artillery will be visited. At Bilbao there will be visits to the manufacturers of railroad cars and to the arms factory of Fibar, and the trip will conclude at St. Sebastien. During the sojourn in Spain a number of social events will take place, and while the visitors are in Madrid a reception will be held at the royal palace.

The FOUNDRY Family Photograph Album

Upper Left
S. T. JOHNSTON,
S. Obermayer Co.,
Chicago

Lower Left
H. FOSTER BAIN
American Institute of Mining & Metallurgical Engineers,
New York

Upper Right
R. A. BULL
Steel Founders Research Group,
Chicago

Lower Right
C. M. BARNEY
Worthington Pump & Machinery Corp.,
New York

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 700)

Polishing Qualities

The property of being able to produce by polishing, a mirror-like finish.

Most of the irons and steels take a polish to a certain extent but few of them will retain this polish because of surface oxidation. Alloy steels take and retain a better polish than ordinary steels, especially high chrome steels. Semi-steel takes a better polish than cast iron. A polished surface is usually a good bearing surface. Cast iron and semi-steel take a good polish and are also good bearing materials; the best of the iron carbon series.

Machinability

The relative ease of finishing by the machining operation is a measure of the machinability of a material. No adequate numerical scale has been worked out.

Wrought iron—Machinable.
Steel—Machinable.
Malleable iron—Machinable.
White iron—Cannot be machined.
Grey cast iron—Machinable.
Semi-steel—Somewhat harder to machine than cast iron.

Wearing Properties

The resistance to frictional forces.

The Stanton wear test is the slipping of a sleeve on a rod with a circumference of ¼-inch under a load of 410 pounds at a speed of 2000 revolutions per minute. Wear is called reduction of thickness in mils* per 1000 feet of slip.

The wear test by dry rolling (Samter test) is made by driving a 1-inch diameter rod at 2200 revolutions per minute inside a hardened steel ring 1½-inch inside diameter loaded with 410 pounds. The wear is defined as the reduction in diameter in ten-thousands of an inch after making 200,000 revolutions. The resistance to wear is defined as the reciprocal of wear by dry rolling times 1000.

Some values for the resistance to wear are given as follows; the higher the number the greater the resistance:

Soft steel (low carbon)	77
Hard steel (high carbon)	330
Heat treated steel	140
Manganese steel	45

*A mil is 0.001-inch.

(*Continued on Data Sheet No.* 702)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 701)

Melting Point (Temperature)

That temperature at which a solid changes from a solid to a liquid state is called its *melting* or *fusing* point.

	Centigrade Degrees	Fahrenheit Degrees
Pure iron	1530	2786
Wrought iron	1500	2732
Carbon steels	1350–1500	2462–2732
Alloy steels	1300–1500	2372–2732
Malleable iron, White iron	1250–1350	2282–2462
Gray cast iron, Semi-steel	1140–1350	2084–2462

Boiling Point (Temperature)

The temperature at which a liquid changes from a liquid to a gaseous state. It is also called *ebullition point.*

Pure iron—2450 degrees Cent. (4442 degrees Fahr.)

Combustibility

The property to oxidize with the evolution of heat and light.

In highly oxidizing atmospheres, or in pure oxygen, the iron carbon series is combustible at high temperatures. This fact is made use of in the chemical determination of the carbons by fusion.

Fusibility (Refractoriness)

The relative degree of the property of a solid to melt from a solid to a liquid as compared to other solids. Those substances that melt at the higher temperatures are said to be less fusible or more refractory than the others. The term *incipient* fusion as applied to refractory materials means that the refractory is only partially melted.

The iron carbon series has the highest melting point (most refractory) of the common metals and alloys.

(*Continued on Data Sheet No.* 705)

Laying the Hard Copper Ghost

Government and Other Agencies Frequently Called Upon for Information on the Mythical Subject of Hardened Copper

THE so-called lost art of hardening copper is no secret from present day metallurgists and no reward has been offered by the government for its discovery, notwithstanding rumors circulated to that effect. The United States bureau of standards in the past has received many inquiries concerning it, following newspaper stories of the rediscovery of the art by an automobile mechanic and its subsequent sale for a fabulous sum.

There is nothing new or mysterious in hardened copper. Immense quantities are in commercial use and more is being added daily. Any metallurgist today knows how to produce an edged tool of hardened copper as good as any made in prehistoric times, but the knowledge is of no use because of the vast superiority of steel tools now available. Hardened copper, the goal of many an amateur inventor, can be attained by either one of two well known processes, or by a combination of them.

Hardening or tempering may be produced by cold rolling or hammering, cold-drawing, etc. Hard drawn copper wire and cold drawn tubing are examples. To supply the needs of one industry alone, vast quantities of copper trolley wire are hardened in this way.

The second method of hardening copper is to alloy it with a small amount of one or more than one metal. Zinc, tin, aluminum and iron are the common additions. The alloyed metal no longer should be referred to as copper, but should be named according to the chief alloying constituent, brass, bronze, etc. This name may be restricted further according to other additions made, zinc-bronze, nickel-brass, etc. Vast quantities of copper hardened in the general way are in commercial use. Many samples of hardened copper submitted to the bureau for examination have proved to be alloys of copper with small amounts of one of the foregoing elements.

One of the favorite methods of hardening copper is to manipulate the melting, perhaps unwittingly on the part of the melter, so that the resulting metal is impregnated with oxide. Cuprous oxide is soluble in molten copper and alloys with it in exactly the same sense that metals do. Copper hardened in this way is considerably harder and more brittle than pure metal, but is unsuited for most of the purposes for which copper is used.

The term hardened copper has been used in a general sense to refer to copper in which the mechanical properties have been modified in the manner usually understood by the term hardening; an increase in toughness, a decrease in ductility, etc. The popular conception of hardened copper is that of a metal similar to hardened steel and usually implies the ability to carry a cutting edge.

Numerous samples of hardened copper have been submitted to the bureau of standards for examination. In many samples examined the metal was impregnated with cuprous oxide, thus indicating an alloying with oxide during the melting period. The product is harder and considerably more brittle than pure copper and has a peculiar red color. Samples of hardened copper submitted by one inventor were analyzed and discovered to be nothing more than aluminum bronze, an alloy well known for many years and extensively used at present.

Attempt also had been made to stiffen and harden the material by rolling, but the result was decidely inferior to what would be considered even fair in ordinary commercial practice. Several years ago a manufacturer distributed a small aluminum bronze cold chisel as an advertising novelty. This chisel actually would cut soft steel, but the edge soon became dull. It was superior to the bronze and hardened copper axes of prehistoric times and would have represented a distanct metallurgical advance in those days. Today it is only an interesting toy.

Determination of the brinell hardness upon different forms of copper and upon a sample of so called hardened copper submitted to the bureau are shown in the accompanying table.

Brinell Test Shows Up Hardened Copper

	B. H. N., 500 Kg. load 10 mm ball
Hard drawn trolley wire, 23/64-inch diameter	107
Hot rolled, ¼-inch sheet	68
Electrolytic, cathode copper as deposited	59
Hardened copper as submitted, containing 5.5 per cent zinc	39

Popular interest in the so-called lost art of hardening or tempering copper is evidenced by the numerous inquiries on this subject and by samples of copper treated by some secret process in the endeavor to render the metal similar or equal to steel in many of its properties. Numerous patents covering such processes also may be cited as evidence of the interest in this field. Directions given in some of these patents of treatment of the metal are suggestive of methods of manufacture used in medieval times, for example:

Heat the copper at 250 to 315 degrees and subject it while hot to fumes of burnt sugar and animal fat at a temperature below that necessary to form carbon monoxide.

No industrial application appears to have been made of these patented methods for hardening the copper.

Relative to the so-called lost art of hardening and tempering copper or bronze, the following quotation from Wm. Gowland, *Journal of the Institute of Metals*, Vol., VII. Nov. 1, 1912, page 23 is of interest and importance. Professor Gowland of the Royal School of Mines is an authority upon the subject of metallurgy of copper and its uses in antiquity:

Castings, knives, swords, etc., generally were hammered at their cuting edges and it is to this hammering and to it alone, that the increased hardness of the cutting edges of both copper and bronze weapons is due, and not to any method of tempering. Much has been written about the so-called art of tempering bronze, supposed to have been practiced by the men of the Bronze age in the manufacture of their weapons. The hardness also is said to be greater than can be given to bronze of the present day. I should like to correct this error, as it only can have arisen owing to its authors never having made any comparative, practical tests of the hardness of bronze. Had they done so, they would have found that the ordinary bronze of today can be made as hard as any, in fact harder than most, of prehistoric times, by simply hammering alone.

What Beginners Think

(*Concluded from Page* 47)

in the scale house talking loudly and when they saw me approach they glowered at me and stopped talking but none of them moved. I knew that the work would have to proceed and that the heats would have to be poured regardless of any problems I might have and that there was no time to waste. Those huge furnaces would have to be supplied with material. I had the advantage of the men in that I knew how to operate the incline railway machinery, which none of them, not even the craneman, dared to touch. Also, I knew how to use the scales and make the reports. On the other hand, they understood the handling of the work much better, the scheme of tracks and switches and the use of the equipment.

Well, I had to get started, and soon. I knew what was needed for the next heat so I pointed to the nearest car and said "Pig," just as the foreman used to, and wrote 4500 on the first charging box just as he would do it. However, my tone of voice or something must have been different for not a one of them stirred an inch. Instead they began a lively discussion in which the sides seemed to be about equal. To say that I was embarrassed would not tell the story. I felt as if the subject of the discussion, was, "Shall we do what he says or shall we knock him in the head with this bar?"

One Lone Ally

A tall, lumbering fellow with fierce eyes and vast moustaches gradually assumed control of the situation and his counsel prevailed. Slowly, one by one, they started for work without noticing me in the least, evidently determined to give me the impression that their beginning to work bore no relation whatever to anything I had said. However, I felt some relief in that they had started and felt additional relief in the fact that the biggest and, apparently, the most influential member of the gang felt some little inclination to support me.

The remainder of the night was like the beginning. Ordinarily, it took about 45 minutes to load up a heat and set it out for the furnaces. Although the work seemed to go forward and there was no waste of time that I could detect, little more than half the metal was loaded in an hour and the melters were signaling for the removal of the empty cars of the first heat long before the second was ready.

Then, in my agitation, I made an error in planning the disposition of the cars to the various tracks and the correction of the error caused much additional switching of cars back and forth which made the men furious if one may judge by facial expressions, tone of voice and arm and finger motion. The switching back and forth was only partially completed when the furnace men began to call for their charge in a manner loud and unmistakable. Everything came to a climax when the first car ran off the track at the turntable and 10 or 12 tons of metal hung precariously to one side 200 feet beyond the reach of the crane.

Now What to Do

The men immediately sat down to see what I would do. The expression in their eyes made me suspect strongly that this had happened before and that they knew exactly what should be done and knew that I didn't know. And I certainly didn't.

Like a hero in a play the superintendent sauntered into the yard at the moment and saved the situation. In a mixture of English and some other language he spoke to them sharply for doing nothing and sent two of them into the shop whence they returned a few moments later with a big hydraulic jack on a truck. Without another word from him the men brought timbers and blocks and before long had lifted the heavy car to a position from which it slipped back to the track.

In the meantime the superintendent asked me how I liked the boss business. I suppose that my mental state was written all over my face because he appeared to be much amused. I replied with the old saying that, "It wasn't all it's cracked up to be." He asked me what I would have done if he had not come when he did. I told that I would have gone after him because I did not have the slightest idea what to do although it would have meant humiliation thus to admit defeat.

"The trouble," he said, "is that your whole manner indicates to these men both that you are not used to handling workmen and that you are not familiar with this work. They must be taught that you are the boss and you must learn to become a real one. When you go home in the morning think the whole situation over carefully and make your plans for tomorrow night. Then, some day when you have worked into this job a little we will give them a jolt and show them who is running this show."

Before going to sleep I made a sketch of the yard and the tracks and switches from memory and with black, gray and white buttons for cars, I practised switching them until I felt that I should have little trouble the following night.

About a week later I complained to the superintendent on the way home in the morning about one of the men who still caused trouble although the others were falling into line fairly well.

"Tonight I'll give you a pad of pay-off slips. If that fellow gives you trouble again, give him his time. The fact that you are carrying the blanks and write one without hesitating will give them the evidence they need regarding your authority."

I must confess that I waited eagerly for the man to begin his tricks on the following evening and I did not have long to wait. I called him into the scale house and wrote out his payoff slip as calmly as I could, while the others, who recognized the document, stood by in astonishment. I handed the culprit the paper and motioned with my thumb toward the timekeeper's office.

That was the end of my troubles in the yard and marked the beginning of more rapid progress under the truly remarkable guidance of the night superintendent.

Sells Shakeout Equipment

The Stoney Foundry Engineering & Equipment Co., Cleveland, recently has sold shakeout bails to the Chateaugay Ore & Iron Co., Scranton, Pa., the New Orleans Car Wheel Co., New Orleans, La., and the Buick Motor Co., Flint, Mich. That company also has sold vibrators and shakeout equipment to the Rundle Mfg. Co., Milwaukee, the Motor Castings Co., Milwaukee, the Griffin Wheel Co., Kansas City, Kans., the Peru Foundry Co., Peru, Ind., the Brown Car Wheel Works, Inc., Buffalo, the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., the Elmira Foundry Co., Elmira N. Y., the Lakey Foundry & Machine Co., Muskegon Mich., the Fremont Foundry Co., Fremont, O., the Griffin Wheel Co., Council Bluffs, Ia., the Griffin Wheel Co., Cincinnati, the American Foundry Co., Indianapolis, and the Cleveland Co-Operative Stove Co., Cleveland. The West Steel Casting Co., Cleveland, has ordered four power stripping machines from the Stoney company.

E. J. Burnes, for five years pig iron salesman for Pilling & Co., New York, has resigned to become affiliated with the coke department of Semet-Solvay Co., New York.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Measures Temperature

The Measurement of the Temperature of Liquid Cast Iron and Steel, by M. Wenzl and F. Marawe. *La Revue de Fonderie Moderne,* Paris, Sept. 25, 1927.

Experiments were made at the Sterkrade works in Germany, showing the comparative results of optical and thermo-electrical methods. In a reverberatory furnace optical instruments cannot give the temperature inside the bath, so a thermo-electric couple of platinum and platinum-rhodium, protected by a suitable tube, was inserted at different points of the bath. The maximum temperature was found in the molten slag. During pouring optical measurements with an instrument developed by Holborn-Kurlbaum were effected as well. The thermocouple must be completely covered by molten metal over a length of 2 inches. Optical measurements must be taken from the back of the running metal; if taken from the front, vapor interferes with the results. Experiments also were made on the metal pouring from a cupola and from a ladle. Couples of iron and constantan also were used. These deteriorate at 1280 degrees Cent., but they can be utilized again after the weld has been hammered down. These couples are not as expensive as the iron-nickel ones, which are destroyed at 1350 degrees. Experiments also were conducted with basic bessemer pig iron coming from the blast furnace and from a mixer. In the first case the temperature was 1273 degrees with the couple and 1268 degrees with the optical instrument. With the mixer the temperatures were 1242 degrees and 1235 degrees respectively. For steel optical measurements give 1425 degrees. Couples are destroyed. A number of tables showing the results accompany the article.

Estimates Copper Content

The Estimation of Copper in Aluminum Alloys, by H. H. Shepherd, *Foundry Trade Journal* (London) Nov. 10, 1927.

The author employs a standard solution of sodium thiosulphate containing 25 grams of the pure salt in 1000 cubic centimeters of water. This solution is standardized against a solution of copper nitrate containing a known amount of copper. A 30 per cent solution of sodium carbonate is used to neutralize excess nitric acid and a 25 per cent solution of acetic acid is used to give the definite acidity to the solution titrated. Potassium iodide is a 20 per cent aqueous solution and the indicator is a 1 per cent solution of starch. Just enough sodium carbonate is added to the dissolved alloy to produce a slight, but permanent precipitate. The acetic acid is added drop by drop until the precipitate is dissolved. Not more than 1 cubic centimeter of acid should be added in excess. Add 15 cubic centimeters of potassium iodide and shake well and add thisosulphate until the solution turns straw colored. Then add 5 cubic centimeters of starch and finish titration with thiosulphate to a cream color. The end point is sharp if the volume of the sample is kept around 50 cubic centimeters.

Determines Zinc Content

Volumetric Estimation of Zinc in Aluminum Alloys, By H. H. Shepherd, *Foundry Trade Journal,* London, Dec. 8, 1927.

The author believes that when the percentage of zinc in any aluminum alloy exceeds 2 per cent, the determination of this element should be made by the volumetric or potassium ferrocyanide method. The standard ferrocyanide solution is equivalent to about 0.01 gram of zinc per cubic centimeter, and is standardized against pure electrolytic zinc. The alloy is dissolved in a 25 per cent solution of sodium hydroxide, diluted and boiled. The residue of copper, iron, tin and lead is allowed to settle and the solution filtered. The residue is then treated with hot dilute nitric acid; sulphuric acid added and fumed. This solution is again filtered, the liquid being added to the main body of solution from the first filtration. Sodium sulphide is added to precipate the zinc which is filtered off. Dilute, warm sodium sulphide should be used for washing. The zinc sulphide is dissolved in hydrochloric acid and boiled to remove the hydrogen sulphide. A few cubic centimeters of nitric acid are added to oxidize the iron, the solution boiled and neutralized with ammonium hydroxide. The iron is filtered off, and the solution acidified with hydrochloric acid. The solution is heated to 80 degrees Cent. and titrated with potassium ferrocyanide. A 0.20 per cent solution of uranium acetate on a dropping plate is the indicator. The first appearance of a brick red tinge indicates the end of the titration.

Makes Steel Casting Heads

The Steel Foundry; Study of the Head, La Revue de Fonderie Moderne, Paris, Nov. 10, 1927.

This article is a contribution to the article previously written by Marcel Guedras on the subject of steel foundries. The head is defined as a temporary reservoir of liquid steel, made with the object of filling up the empty spaces during the contraction of the cooling metal. Emphasis is applied to the fact that the head is a reservoir of liquid steel, and the subject then is discussed, starting from this basis.

A discussion follows on the most advisable shape to be given to the head, and it is recommended to use a head with a large base, tapering upward, the only objection to this shape being that the cutting of this head will take a little longer. With regard to the size of the head there is no fixed rule, the important point being the position of the head on the casting. It is emphasized that the molding of the heads should be effected with as much care as the molding of the casting itself. The article ends with a discussion on the pouring of the head, reference being made to the introduction into the head of a red-hot steel bar, so that it will be hot when the first metal, which is comparatively cold, is poured into it. Suggestions are given as to the best position of heads.

Presents New Theory

The Constitution of Silicon-Carbon-Iron Alloys and a New Theory of the Cast Irons, by D. Hanson. *Foundry Trade Journal,* London, Sept. 29 and Oct. 6, 1927.

The author determined the cooling curves and examined the microstructure of a number of quenched specimens of an alloy containing only silicon, iron and carbon. From the cooling curves diagrams indicating the transformations occurring in three series containing 0.4, 0.9 and 1.9 per cent silicon were compiled. The author discusses the diagrams and the reasons for his conclusions. He also presents experimental verification of the theory and the application of the theory to cast irons.

Make Black Heart Malleable in France

Malleable Cast Iron, by M. Guédras. *La Revue de Fonderie Moderne,* Paris, Sept. 25, 1927.

This is the fourth article of the series. The author reviews the conditions of manufacture of black heart malleable in France. The composition of the metal before heat treatment is quoted from R. Gailly as follows: Carbon, 2.10 to 2.50 per cent, silicon, 0.70 to 0.95 per cent, manganese, 0.25 to 0.30, sulphur, 0.07 to 0.10, phosphorus 0.15 to 0.20. These limits are not considered as absolute. The author states that M. Gailly favors the reverberatory furnace, but for production costs to be acceptable, two melts of 20 tons should be effected daily. The author claims that in a steel foundry the converter, properly handled, can be used to make malleable iron. He is in favor of the electric furnace, but the current in France is too expensive. Finally, the author states that black heart malleable iron can be obtained with the cupola. By using steel scrap and reducing the coke charge one can obtain iron with 2.55 per cent carbon. A thorough investigation has been made in that direction in France by Ch. Derulle.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Fighters Wanted

SOME time ago manufacturers of incandescent lamps began an investigation to determine reasons for a falling off of new wiring installations. This analysis indicated that the electrical industry nearly has completed the work of putting wiring into homes where electric service is available. Approximately 16,000,000 houses in the United States now are wired for electric light and only about 2,000,000 unwired houses are within reach of electric power lines. Naturally this condition decreased the demand for incandescent lights.

HOWEVER, the manufacturers of that product were not content to see a big slice carved from the market without bending every effort to find other markets. Realization of the condition caused the commercial elements of the industry to heed the advice of the illuminating engineering group which pointed out the inadequacy of present wiring and luminaire installations to meet the needs of American families. Specifications were prepared covering illuminating performance, electrical and mechanical construction and appearance. Electrical service companies now are undertaking refixturing campaigns, which bid fair to more than make up the falling off caused by the approach of the saturation point.

WHAT is the foundry industry doing under circumstances which confronted the lighting interests? Now and then a foundryman undoubtedly feels sure that the industry is going to the dogs and that in a few more years the castings shop will be as extinct as the wild buffalo herds that roamed the western plains in the early days. He is too ready frankly to admit that he has received a knockout blow and now is waiting on the canvas to be counted out. Why? Simply because a good customer has decided to use a stamping where formerly a cast part was used.

However, the foundryman may find the introduction of a different type of equipment, a few changes in melting, molding and cleaning processes and a redesign of the metal part in question will make it possible to meet the competition of the stamping manufacturer. Even better, it may be possible to cut a slice from his production costs which will allow him to sell the casting at a lower price than that asked for the stamping, and still make a reasonable profit. Superiority of the cast product, due to greater strength, resistance to corrosion, and a higher resistance to wear should be pointed out to the purchaser.

IN THE past the foundryman has sought sympathy, nothing more. Nothing can be accomplished by such an attitude. Since the early days of the industry, foundrymen have been looked upon as a practical lot of real men who would little dream of trying to avoid a conflict when their rights were in danger. Now if ever is the time for every foundryman to assume that role.

¶ Philadelphia Calls

UNUSUAL interest is expressed by foundrymen in the forthcoming convention of the American Foundrymen's association to be held in Philadelphia during the week of May 14. In addition to the technical sessions which were the central interest of the Chicago convention held June 6 to 10 at the Edgewater Beach hotel, the Philadelphia convention will be the scene of one of the largest exhibitions ever held where foundry equipment and supplies have been displayed. The attraction of these foundry shows undoubtedly grows. The last previous exhibition, held in Detroit, in the late fall of 1926, drew the largest attendance on record. With the elapsed period of more than eighteen months, many new devices, improvements in known mechanical aids and the development of new ideas will act as a magnet to thousands of foundry executives and officials. Additional features have been planned by officials of the American Foundrymen's association for the Philadelphia convention. Among these an exhibition of castings and practical short courses of instruction on cupola operations will prove especially valuable. No progressive foundryman in this year of grace, 1928, can afford to miss the Philadelphia gathering.

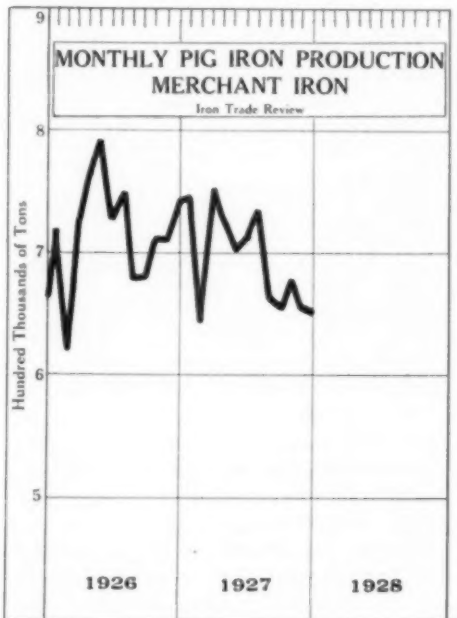
Let's Go.

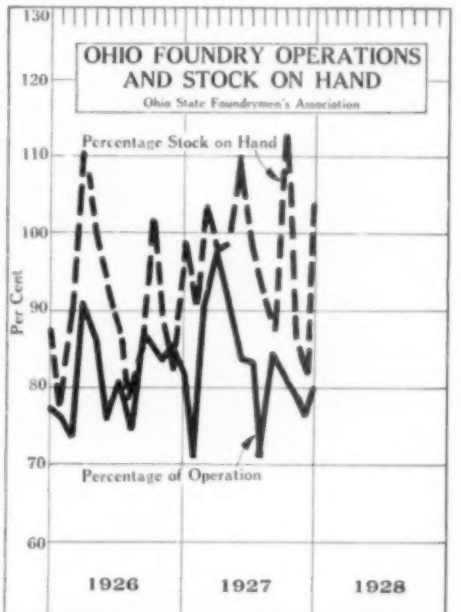
Trade Trends in Tabloid

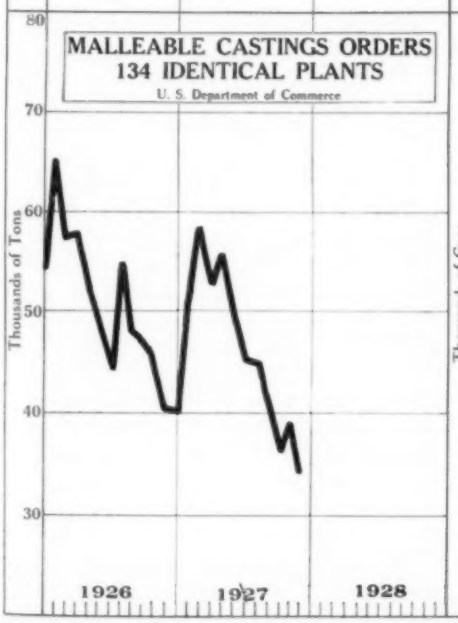
WITH the turn of the year passed, signs of development are shown in support of of the statements made late in 1927, that business would be better in the new year. Railway purchases have picked up, the December orders for about 13,000 cars giving encouragement to foundries making railway sundries. Further, unfilled orders for locomotives show a gain for the first time in seven months. Iron and steel prices have weakened. Automobile production which declined to a low level in November showed signs of building up in December and the month of shows is expected to revive activity in this line. Summaries of building construction figures indicate that 1927 practically equaled the previous year. A survey by the *Architectural Forum* indicates that 1928 will show an equal if not larger volume of construction in 1928 than in the past year. Pig iron production during 1927 was the lowest since 1924, according to an annual summary in *Iron Trade Review*. The total output of blast furnaces was 36,270,000 tons in 1927, compared with 39,100,000 tons in 1926. Average monthly New York prices for nonferrous metals, according to the *Daily Metal Trade*, give the following figures for December: Casting copper, 13.791c; electrolytic copper, 14.051c; Straits tin, 58.464c; lead, 6.514c; antimony, 11.125c; aluminum, 24.756c.

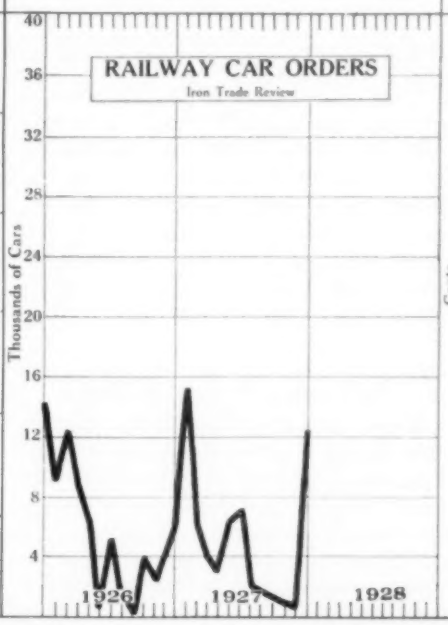
RAW MATERIAL PRICES
Jan. 7, 1928

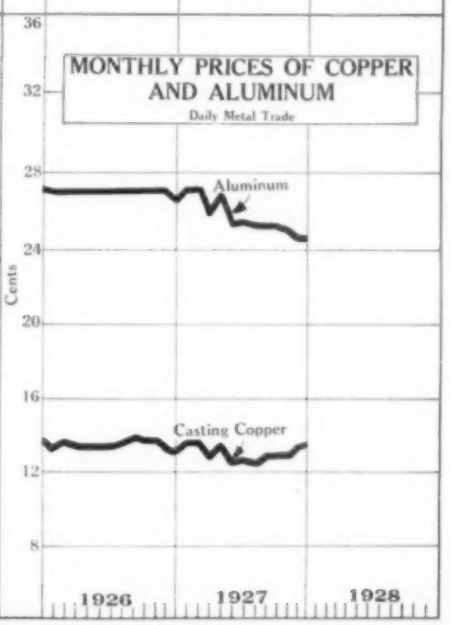
Iron	
No. 2 foundry, Valley	$17.25 to 17.50
No. 2 southern, Birmingham	16.00
No. 2 foundry, Chicago	18.50
No. 2 foundry, Philadelphia	19.76 to 20 26
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.00
Basic, Buffalo	16.50 to 17.00
Malleable, Chicago	18.50
Malleable, Buffalo	17.50
Coke	
Connellsville foundry coke	$3.50 to 4.75
Wise county foundry coke	4.00 to 5.00
Scrap	
Heavy melting steel, Valley	$14.75 to 15.00
Meavy melting steel, Pitts	15.50 to 15.75
Heavy melting steel, Chicago	12.25 to 12.75
Stove plate, Chicago	12.00 to 12.50
No. 1 cast New York	13.00 to 13.50
No. 1 cast, Chicago	14.00 to 14.50
No. 1 cast, Philadelphia	16.50 to 17.00
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	14.00 to 14.50
No. 1 cast, Buffalo	11.50 to 12.00
Car wheels, iron, Pittsburgh	14.75 to 15.25
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	13.50 to 14.00
Agricultural Mal., Chicago	11.75 to 12.25
Malleable, Buffalo	14.50 to 15.00
Railroad malleable, Pitts	14.50 to 15.00
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.75 to 13.87½
Electro copper, producers	14.12½
Straits tin	56.62½
Lead, New York	6.50
Antimony, New York	10.87½ to 11.00
Nickel, electro	37.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 18.00
Zinc, East St. Louis, Ill.	5.65











Personal

T. F. Schlade, formerly vice president, Federal Radiator Co., Zanesville, O., no longer is associated with the firm.

F. J. McGrail, Fairbanks, Morse Co., Three Rivers, Mich., recently has recovered from a severe illness and will spend some time in Florida to recuperate his health.

Charles L. Newcomb has resigned as works manager of the Deane works, Worthington Pump & Machinery Corp., Holyoke, Mass., after 46 years of active service in the mechanical industries. Hugh Benet, formerly with the Baltimore office of the firm, succeeds him.

George F. Pollock, vice president and treasurer, Burnside Steel Foundry Co., Chicago, has resigned to become vice president of the Nugent Steel Castings Co., Chicago. Before entering the foundry industry, Mr. Pollock had been with the purchasing department of Chicago, Burlington & Quincy railroad, and later with the Wheeling & Lake Erie railroad. W. A. Spuehler has been elected vice president and treasurer of the Burnside company and H. J. Finley has been made secretary.

Appointed Manager

E. C. Geither has been appointed manager of the Ingersoll-Rand Co. of Illinois, Chicago. Following his graduation from Purdue university, Lafayette, Ind., he spent a few years with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. In 1913 he became affiliated with the Ingersoll-Rand organization and three years later was made district manager at New York. During the war he was active in the firm's government operations and at its close was made assistant general sales manager. Mr. Geither held that position until 1921 when he took charge of the New England territory, serving there until his recent advancement.

Gives Foundry Course

University of Cincinnati, Cincinnati, is conducting a special course on the chemistry and metallurgy of the foundry in the evening school of the college of engineering and commerce. George M. Enos, department of chemical engineering of the university, is the principal lecturer and in charge of the course. The course consists of twelve meetings which started on Oct. 28 and are held each Friday night from 7:30 to 9:30 p. m. Speakers on special subjects have been engaged to address the meetings and include H. B. Swan, Cadillac Foundry; William Kihn, formerly foundry engineer of the Worthington Pump & Machinery Corp.; William Rengering, metallurgist, Modern Foundry Co., and John W. Bolton, metallurgist, Lunkenheimer Co.

Will Retire from Firm

Leonard W. Williams will retire from the firm of Park & Williams Inc., Philadelphia, and about Feb. 1 will join the firm of Stone, Williams & Kayes, real estate, of that city. Park & Williams was organized in 1916 by Mr. Williams and Laird U. Park and the latter will continue business without change of name. The firm is sales agent for merchant pig iron produced by Alan Wood Iron & Steel Co., district agent for Superior Sheet Steel Co., and the Vulcan Mold & Iron Co.

Index Is Ready

AN INDEX of all articles appearing in THE FOUNDRY *during the year* 1927 *has been prepared for distribution. The index gives references and cross references to articles in the entire* 24 *issues. Readers who bind or preserve the past issues of this publication will find the index of considerable value. It will be mailed free to any reader who requests it from* THE FOUNDRY, *circulation department, Penton building, Cleveland.*

Opens Consulting Office

Joseph B. Diesher, for three years a consulting engineer with the American Malleable Castings association and the Malleable Iron Research institute, and more recently in Europe as consulting foundryman, has entered business for himself in that capacity with headquarters at 24 Roslyn street, Rochester, N. Y.

Arranges Itinerary

Plans are being completed for the European tour arranged by the American Ceramic society which will begin May 19 and continue until July 5. Plants of the foremost ceramic manufacturers will be visited in France, Czechoslovakia, Germany, Holland and England.

Plan Overseas Meeting

Preliminary plans already are taking shape for the third International Foundrymen's congress which will be held in London, England, in 1929 under the auspices of the Institute of British Foundrymen. It has been decided to hold the congress June 11 to 15 instead of May 28 to June 1, 1929, as previously announced. The American Foundrymen's association officially has joined the International Foundrymen's committee which has been formed by representatives of foundry associations, including those of Great Britain, France, Belgium and Germany. This committee will make arrangements for the next and succeeding international congresses.

Resigns Position

Brent A. Tozzer, New York sales manager for the Niles Tool Works Co., and Pratt & Whitney Co., 111 Broadway, New York, has resigned. He entered the machine tool industry in 1901 with the Lodge & Shipley Machine Tool Co., Cincinnati, with which he served until 1908. Mr. Tozzer then became associated with the Niles-Bement-Pond Co., and Pratt & Whitney Co. and went to Cleveland, where he organized a branch office. He managed this office until 1925 when he was transferred to New York.

Form Accountancy Firm

A new firm of accountancy with 32 partners from as many cities recently was formed and will operate under the name of Pace, Gore & McLaren, New York. Members of the new firm practice as individuals or as members of firms of various cities. Working arrangements also have been made with 15 other accountancy firms. Carl H. Nau of Nau, Taylor & Swearingen, Cleveland, is one of the members from Ohio.

Hold Regular Meeting

The ninth monthly meeting of the Wisconsin Gray Iron Research group was held at the Republican house, Milwaukee, Wednesday, Jan. 11. Arthur E. Hageboeck, secretary-treasurer, the Frank Foundries Corp., Moline, Ill., addressed the meeting on the subject "Cost Control in the Gray Iron Foundry." Mr. Hageboeck is a director of the American Foundrymen's association and chairman of the conference on foundry costs.

Delaware Brass & Aluminum Co., Muncie, Ind., recently has changed its name to the Beckett Bronze Co.

Sanitary Ware Makers Effect Merger

Plans for the merging of the J. L. Mott Co., New York and Trenton, N. J., the Laib Co. and the Columbia Sanitary Mfg. Co., Louisville, Ky., recently were announced and the merger is now in process of accomplishment. The consolidated group, which also includes seven subsidiary companies, will be known as the J. L. Mott Co. Inc. With the extensive Mott plant in Trenton, and the Columbia works at Louisville, each of which has an area of approximately 25 acres, the manufacturing and distributing facilities of the new $10,000,000 concern will constitute one of the largest units in the industry.

George H. Laib, president of the Laib company, will head the new company and will have associated with him W. G. Probst, vice president of the Columbia Sanitary Mfg. Co., and Jordon L. Mott, 3rd. Mr. Probst is general manager of the new company, and will direct both the Trenton and Louisville plants. Present business will require the operation of both the Mott and Columbia plant at capacity, and it is understood that the ornamental iron branch of the Mott business will be expanded.

The Mott business started in 1828 when the J. L. Mott Iron Works was founded at Mott Haven, now a part of New York city. About 25 years ago the business was moved to Trenton. The Laib company was founded in 1901 and has steadily expanded since that time. The Laib subsidiaries included in the merger are the Plumbing & Heating Supply Co., Nashville, Tenn., and the Huron Plumbing Supply Co., Toledo. The Laib company also has branches in Benton, Ill., Evansville, Ind., Detroit, and Cincinnati. The Mott subsidiaries are the J. L. Mott Iron Works, the Trenton Fire Clay & Porcelain Co., Mott Co. of Pennsylvania, Mott Southern Co. of Atlanta, Ga., and the Mott Co., Limited, of Canada.

Obituary

William L. Belknap, treasurer and general manager, Belknap Mfg. Co., Bridgeport, Conn., died recently at his home in that city.

Henry V. Wille, consulting vice president in engineering and metallurgy for the Baldwin Locomotive Works, Philadelphia, died recently in that city at the age of 59 years.

Frank H. Jones, vice president and director of the Michigan Steel Castings Co., Detroit, died Dec. 10, 1927. Mr. Jones also was vice president and treasurer of the Puritan Mortgage Corp., New York, and a director of the Crocker-Wheeler Co.

Arthur F. Blasdell, who resigned as works manager of the General Electric Co., Pittsfield, Mass., in Dec. 1926, died recently at Santa Ana, Calif., at the age of 56 years. Mr. Blasdell had been manager of the Pittsfield plant for 16 years.

Watson J. Hasselman, a founder of the Sinker-Davis Machine Co., Indianapolis, died recently at Battle Creek, Mich., at the age of 74 years. He was born in Indianapolis and founded the Washington Foundry & Machine Works.

James Doherty, vice president, Utica Heater Co., Utica, N. Y., and a director of the National Radiator Co., died recently at his home in Chicago at the age of 58 years.

Senter M. Jones, first vice president, manager of purchases and member of the executive committee, Century Electric Co., St. Louis, died recently at the age of 47 years. Mr. Jones entered the Century organization in 1906 and took a keen interest in employes' activities. He was a member of the American Institute of Electrical Engineers, St. Louis Electrical board of trade and the St. Louis chamber of commerce.

Walter Scott Bowler, vice president of the Bowler Foundry Co., Cleveland, and a director of the Buckeye Steel Casting Co. Columbus, O., died Jan. 1 at his home in Shaker Heights, O., at the age of 55 years. Mr. Bowler was graduated from Hiram college, Hiram, O., and started with the Lake Shore Banking & Trust Co., Cleveland, more than 30 years ago and was vice president when that firm was merged with the Cleveland Trust Co. in 1922. At the time of his death Mr. Bowler was vice president of the Cleveland Trust Co., and the Ohio Confection Co. He also was a director of the Wheeling & Lake Erie railroad; Cleveland Steel Co., and the Norris Allister, Ball Co.

Charles Henry Zehnder, for many years a prominent figure in eastern iron industry died at his home in New York on Dec. 26. He was born in Northumberland county, Pennsylvania, in 1856 and received his education at Danville academy, Danville, Pa. In 1880 Mr. Zehnder became secretary to the vice president, Jackson & Woodin Mfg. Co. and later became general manager and president of the firm. He left the company in 1896 to become president of the Dickson Mfg. Co., Scranton, Pa. In 1902 he became president of the Allegheny Ore & Iron Co., which position he occupied until 1907. At the time of his death Mr. Zehnder was a director of the Warren Foundry & Pipe Co., Phillipsburg, N. J., and its associated companies; president of the Mount Hope Mineral Railroad Co. of New Jersey and vice president, Scranton Bolt & Nut Co., Scranton, Pa. Mr. Zehnder was a member of the American Iron and Steel Institute and other organizations.

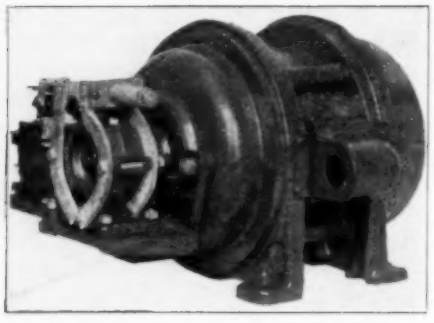
Officers Are Elected at Anniversary Meeting

The thirty-second anniversary of the New England Foundrymen's association was celebrated at a meeting held in the Exchange club, of Boston, Wednesday evening, Jan. 11. A special dinner was served at six o'clock and special entertainment was provided for the evening. The association elected the following officers for 1928 at the meeting: President, Charles F. Miller, Universal Winding Co., Providence, R. I.; vice president, Carl H. Neumann, Union Mfg. Co., New Britain, Conn.; treasurer, George H. Gibby, Gibby Foundry Co., East Boston, Mass.; secretary, Fred F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass. The following members of the executive committee were elected; Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass.; William W. Brierly, Millbury Steel Foundry Co., Millbury, Mass.; H. A. Lincoln, Sullivan Machinery Co., Claremont, N. H.; Luther J. Anthony, Glenwood Range Co., Taunton, Mass.; Charles A. Reed, Rogers, Brown & Crocker Bros. Inc., Boston.

Reviews Chromium Plating Processes

Recently the department of engineering research, University of Michigan, Ann Arbor, Mich., published a bulletin by Richard Schneidewind. The bulletin deals with the various patents associated with the electrodeposition of chromium. This is engineering bulletin No. 8 and the price is 50 cents.

The International Nickel Co., New York, recently has distributed a handy reference card on nickel additions to gray cast iron. This card is the loose-leaf type 3¾ x 6¾ inches and may be placed in a notebook for reference. It gives properties and applications of nickel iron, additions per 100 pounds and mixtures for various purposes.



THREE PHASE, ALTERNATING CURRENT, SQUIRREL CAGE, HOIST MOTOR WITH BRAKE

Motors Are Enclosed

The General Electric Co., Schenectady, N. Y., has developed a new line of motors suitable for portable electric hoists and also for other applications involving intermittent operation and high starting torque. The lines run from 1 to 10 horsepower in the direct-current types; from 1 to 11 horsepower, single speed, 3 and 2 phase, and from 1 to 5 horsepower, single phase, in the alternating-current types. Three and two-phase, slip-ring type hoist motors also are included from three horsepower up.

The new motors are enclosed totally and all parts are protected. Bearings are of the waste-packed, sleeve type, being closed against the entrance of dirt from the outside. The direct-current motors are series wound. The alternating-current motors of the polyphase type have high-resistance rotors, while the single-phase motors have an unusually high starting torque.

In a great many of the applications of these motors a brake is required. Accordingly the motors are all built with the shaft extension away from the drive to take a brake, and the motor end-shield at this end is fitted with pads or bosses with drilled and tapped holes for mounting the brake.

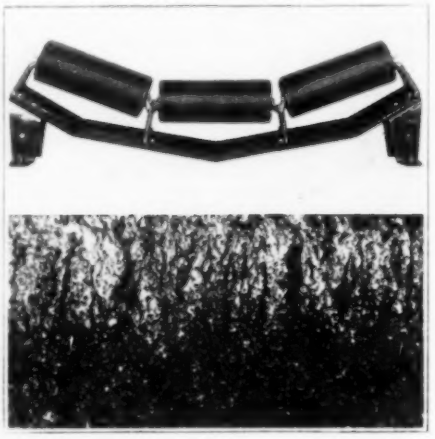
Book Review

Index to Proceedings, cloth, 224 pages, 6 x 9 inches, published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland, for $2.50 in cloth and $3.50 in half-leather. In London, 416-17 Caxton House, Westminster, the prices are 12s 6d and 17s 6d, respectively.

This is the third index of the *Proceedings* published by the American Society for Testing Materials and covers the years of 1921 to 1925. Previous years are covered by two other indexes. This volume contains a comprehensive subject index of material published in the *Proceedings*, an author index listing the names of those who supplied papers or entered into discussions or signed committee reports, and a complete table of contents of the five years covered. This index should be convenient in locating articles or reports contained in the *Proceedings* during those years.

Surface Is Chilled

The Stearns Conveyor Co., Cleveland, has introduced a new anti-friction, cast-iron pulley having the outer surface made of chilled iron. The surface is extremely hard to withstand severe service wear under a wide range of conditions from extreme heat to cold. Although chilled iron, the metal commonly used in plow shares, railroad car wheels, traction wheels, etc., is difficult to produce in small castings, the company has succeeded in making a chill of even depth, as may be noted in the accompanying illustration. The metal



CAST IRON IS CHILLED TO A UNIFORM DEPTH

grades from the chilled iron on the surface to a gray iron, giving the pulley a hard, smooth, wear-resisting surface with a relatively tough inside. A combination grease seal keeps dirt out of the bearings and holds the grease in place.

Issues Tentative Standard

The American Engineering Standards committee recently has issued proposed tentative standard for Symbols for Heat and Thermodynamics. This is being distributed for criticism and comment. Suggestions and changes should be addressed to Preston S. Millar, secretary of the sectional committee, Electrical Testing Laboratories, Eightieth street and East End avenue, New York.

Stephens-Adamson Mfg. Co., Aurora, Ill., has purchased outright, the Marsh Engineering Works, Belleville, Ont., manufacturer of hoisting machinery, and will operate the plant as its Canadian branch.

Changes Hoist Design

The Chisholm-Moore Mfg. Co., Cleveland, recently has made changes in the design of its high-speed chain hoist. The new hoist is constructed on the same gyrating yoke principle that is to be found in the previous model hoist.

Anti-friction bearings are used at every rotating point. Altogether, eight ball bearings, four roller bearings and one thrust roller bearing in the lower swivel hook are used to help increase the new hoist's efficiency. Roller bearings are built in one complete unit.

The company has developed a new alloy steel for making the lift wheel. All parts of the new hoist are interchangeable. As with the previous model, the entire mechanism of the hoist is enclosed in a dust-proof, oil-tight frame. Because of the special attention to the distribution of material used in construction, the hoist is light in weight, making it possible to carry to smaller models easily from one job to another.

Bruce Wagner has joined the laboratory research division, Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

THE MECHANISM IS ENCLOSED IN A DUST PROOF CASE

Jolt Machine Presents Many New Ideas

Several new ideas designed to increase speed, simplicity and safety of operation have been incorporated in a jolt molding machine recently introduced by the Johnson & Jennings Co., Cleveland and shown in the accompanying illustration. Formerly specializing in small sizes of molding machines the company developed this machine to handle medium size and large molds. Up to the present it has concentrated on three sizes. But the design, it is claimed, easily may be adapted to practically any size.

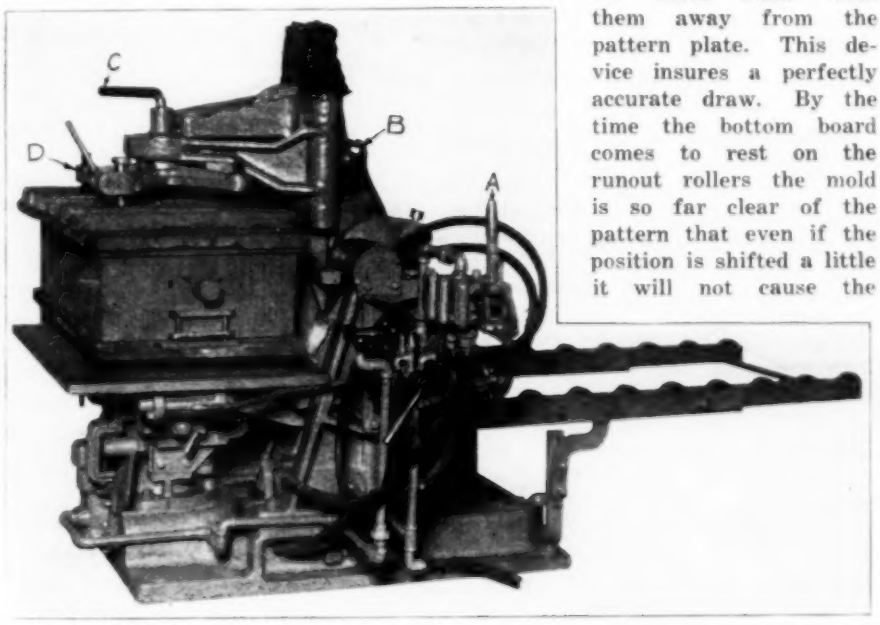
Two of the outstanding features of the machine are the rollover equipment and the device which answers the double purpose of clamping the mold and drawing the pattern. The machine is equipped with five cylinders. One for jolting the sand, two for rolling the mold, one for cushioning the fall of the mold and one for drawing the pattern. Four operate on air. The fifth uses oil. Valve control levers all are conveniently located at one central point.

The machine is designed to be mounted directly on the floor without any pit or special foundation. A large and wide base is provided to absorb the shock on the anvil during the jolting operation. After the mold has been jolted a swinging arm *B* is adjusted so that the four-way cross *D* comes under a pair of brackets projecting horizontally from a head which travels up and down in a pair of heavy guides. The head is actuated by an air cylinder mounted on the opposite side to the brackets. The cross is hung loosely through a ball and socket joint and in that manner the four set screws at the extremities adjust themselves automatically to any inequalities in the cleats on the bottom board. Under ordinary working conditions the cross is forced against the bottom board under a pressure of 3000 pounds. This eliminates the necessity of applying any clamps to the mold before it is rolled over.

The pattern plate is attached to a pair of long brackets forming part of the main frame. The main frame swings on a shaft that is provided with three short arms near the center corresponding to the throws on an engine crankshaft. Piston rods from two air cylinders mounted on trunnions are attached to two of these arms and are employed in rolling the mold. Air pressure is regulated through a piston type valve operated by the handle *A*.

In practice air is admitted to both cylinders until the piston rod in one comes to a dead center and the mold has been elevated to a point directly over the center. The air then is exhausted from the first cylinder and as a result the second cylinder pulls the load past the center. Diminishing pressure in both cylinders allows the load to descend slowly. An additional check on the descent is furnished through an oil cylinder with a piston rod attached to a third throw on the shaft.

After the mold has been rolled over, pressure is released on the cylinder actuating the clamping device and as the head and cross sink the mold sinks with them away from the pattern plate. This device insures a perfectly accurate draw. By the time the bottom board comes to rest on the runout rollers the mold is so far clear of the pattern that even if the position is shifted a little it will not cause the pattern to touch the sand. The cross continues to sink and leaves the mold clear on the runout rollers. Then the mold is pulled forward under the reach of a crane and the machine with pattern plate attached is rolled back to the original position.



THE SQUEEZING DEVICE ON THE TOP HOLDS THE BOTTOM BOARD IN PLACE UNTIL THE MOLD IS ROLLED OVER, THEN IT SINKS AND ALLOWS THE MOLD TO LEAVE THE PATTERN PLATE BY GRAVITY

THE BEAM BALANCES AUTOMATICALLY

Dial Shows Weight

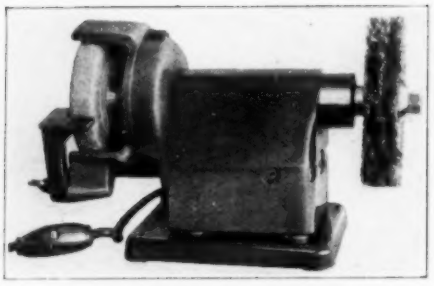
The Standard Scale & Supply Co., Pittsburgh, recently has introduced a new type of electric dial scale. This scale combines the precision balance principle of the chemist's scale with the automatic electric poise shift which permits the beam to balance automatically. It is claimed that the balance owes its accuracy to the use of razor edged, hardened steel pivots which rest on equally hard bearings.

The electrically operated poise automatically strikes a perfect balance and the compensating beam correctly gives the combined net, gross and tare weight at a single glance. The weight to a split pound is shown through an electrically lighted dial window. The scale is adaptable to any type of heavy duty beam scale.

Award Tunnel Sections

Recently the largest tonnage of cast segments ever to have been placed in the New York district for a board of transportation project has been awarded by Mason & Hanger, general contractor in charge of construction of the Fulton street tunnel under the East river. Fifty-four thousand tons were involved and divided equally between the Bethlehem Steel Corp., Bethlehem, Pa., and Davies & Thomas, Catasauqua, Pa.

Gibson & Halpern, machinery sales engineer, has removed its office from 63 Wall street to 15 Park Row, New York. The firm handles machine shop and foundry equipment, and aluminum, bronz and iron castings.



THE MACHINE IS EQUIPPED WITH A GRINDING WHEEL AND WIRE BRUSH

Introduces Grinder

The Black & Decker Mfg. Co., Towson, Md., recently has introduced a combination grinder for cleaning and buffing. The universal motor is ball bearing mounted and has a speed of 2400 revolutions per minute. The grinder is furnished complete with a 5-inch grinding wheel on the left side of the spindle and a 6-inch wire wheel brush on the right side of the spindle. The wire wheel brush is interchangeable with buffs.

Purchases Plant

The Norton Co., Worcester, Mass. has purchased the entire capital stock of Bethel-Player & Co. Inc., Westboro, Mass., manufacturer of modern lapping machinery.

It is the intention of the Norton company to make these products in their Worcester plant and market them through the Norton sales organization.

The Bethel-Player products consist of crankshaft lapping machines, cylindrical and flat lapping machine, hole and cylinder lapping machines, and tool room bench laps. These machines find a market in manufacturing plants producing automobiles, aero engines, electrical apparatus, calculators, fine tools and gages, pneumatic tools, high pressure pumps, roller bearings and optical goods.

Appointed Representative

Eugene D. Milener, formerly associated with the Consolidated Gas, Electric Light & Power Co., Baltimore, now is industrial gas research representative for the American Gas association. His duties will include contact and field work for the association's committee on research in industrial gas utilization. This committee has direct charge of the $500,000 research program of the American Gas association. Mr. Milener was graduated from Baltimore Polytechnic institute and the University of Maryland. He entered the employ of the Consolidated company in 1910 and served in various departments. Mr. Milener has been active in committee work for the Gas association and has written extensively on industrial application for gas and the use of gas for house heating.

Builds Chipping Hammer

The Cleveland Pneumatic Tool Co., Cleveland, has announced a new high speed chipping hammer. It is claimed that this tool is air balanced and each of its moving parts is so synchronized as to eliminate any vibration or recoil in operation.

The throttle valve is the two stage type, which graduates the air supply and regulates the force of blow. The valve is the ball type and has a graduating apron at the front so tapered as to allow the air to pass into the hammer gradually. As the thumb latch is further depressed the

THE THROTTLE GRADUATES THE AIR SUPPLY

movement of the piston is accelerated gradually until the maximum speed and power of blow is reached, thus eliminating recoil or vibration in action. No air vent port is required in the throttle valve and therefore no loss of air is experienced at this point.

The cylinder at its forward end is reinforced by a tapered retaining wall and the piston is tapered correspondingly. The piston has liberal bearing surface. The main valve is the spool type and is reinforced at lower end.

Determines Temperature

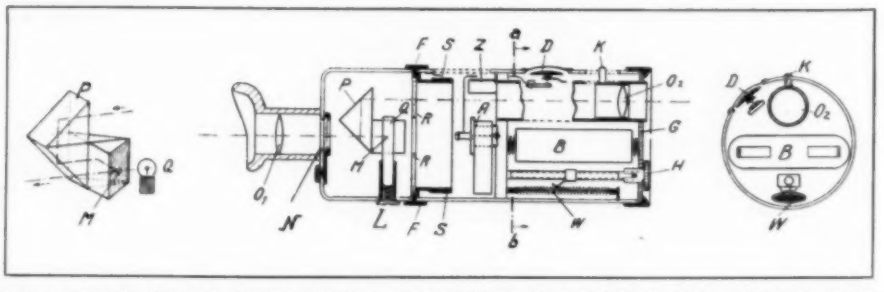
The Pyrometer Instrument Co., 74 Reade street, New York, recently has introduced an optical pyrometer designed for such work as determining the temperature of pouring metal or of small glowing bodies not enclosed and not having the characteristics of a black body. This pyrometer is used like a telescope and magnifies the object four times its actual size. The object appears in its natural colors.

Light rays of the object to be measured are concentrated through the objective, shown as O_2 in the accompanying illustration, in such a way that they are thrown on the plane M of the system of prisms P and are seen clearly through the eyepiece O_1. The plane M of the prism has a small transparent test mark, which appears to the eye as a small clear cut elliptical ring. This ring is lighted by a small electric lamp Q, by pressing the contact button D. The lamp receives current from the common dry cell battery B of approximately 60 millamperes and can be adjusted by a rheostat W in connection with the milliammeter A.

This small elliptical ring in the range of vision, which at a distance of about 40 feet covers the area of a nickel, represents the standard brightness, burning with constant intensity. The observed body is compared with this light. To operate the instrument is sighted in such a way that the testmark covers the object to be measured and the brightness of the range of vision is adjusted until the test mark disappears. To accomplish this a circular color filter has been inserted between O_1 and P, with graduating density of color R. Rotating this by the adjusting band F filters the color of the object until the brightness of the test mark is matched. The temperature then is indicated on the scale S.

Install New Furnace

Imperial Steel works, Edgar Allen & Co. Ltd., Sheffield, England, recently installed a 450-pound, high frequency, induction melting furnace for the production of crucible steel. The furnace was installed by the Electric Furnace Co. Ltd., London, which controls the British rights for the Ajax Electrothermic Furnace Corp., Trenton, N. J.



THE PYROMETER IS USED LIKE A TELESCOPE, MAGNIFYING THE OBJECT FOUR TIMES ITS NATURAL SIZE

Holland Tunnel Built of Cast Iron

In an attractive 64 page book, illustrated with 40 views of the work in progress, the B. F. Sturtevant Co., Boston, has included a summary of nearly all the salient facts connected with the construction and operation of the Holland tunnel connecting New York with Jersey City under the waters of the Hudson river. The book is entitled *The Eighth Wonder* in reference to the so-called seven wonders of the world compiled some time in the second century A. D. by one Antipater of Sidon. The walls of Babylon, the statue at Olympia by Phidias, the hanging gardens of Babylon, the colossus at Rhodes, the pyramids of Egypt, the mausoleum at Halicarnassus and the temple of Artemis at Ephesus.

Any list made up today surely would include the Holland tunnel, named after its first chief engineer who died under the strain before the work was completed. His succesor also broke under the burden and the work was completed under Ole Sinkstad the present chief engineer who had been assistant, first to Clifford M. Holland and later to his successor Milton H. Freeman.

The tunnel with its twin tubes 29 feet 6 inches in diameter made up of cast iron rings and lined with white tile is the largest subaqueous tunnel in the world, exceeding the diameter of the Rotherhithe tunnel under the Thames at London, England by 4 inches and exceeding its nearest rival in America, the Pennsylvania railroad tube between New York and Jersey City by 6 feet 6 inches. The Holland tunnel has a total length of 9250 feet, an under river length of 5480 feet and a capacity of 1900 vehicles per hour in each direction or a total of 46,000 per day. Obviously with the majority of this traffic motor driven the ventilation problem was of some moment. How it was solved by the development and installation of 84 giant fans made by the B. F. Sturtevant Co., forms an interesting and informative section of the book.

Celebrates Fiftieth Anniversary

Fifty years ago the Moline Iron Works, Moline, Ill., began in a modest way in Chicago. The firm name at that time was the C. J. Cooper Co. and it manufactured and finished harness hardware from purchased malleable castings. Later, the firm decided to make its own castings and removed to Moline. At the present time the Moline Iron Works has three large plants which include two malleable iron foundries with a capacity of 12,000 tons of finished castings a year. Over 500 employes are given work in the three plants.

From the single line of harness hardware, the products have increased to include automobile accessories, plow clevises, foundry molding machines, kitchenware, brass and aluminum patterns and a varied line of malleable castings. These castings are used in the agricultural implement, railway car, automobile, washing machine, electrical supply and other industries, and range in weight from ½-ounce to over 125 pounds. M. C. Nutt is president of the Moline company.

Faked Foundry Facts

Slinging the Bricks

Install Many Furnaces

During 1927 a marked increase in the number of installations of high frequency induction furnaces made by the Ajax Electrothermic Corp., was noted. Among the installations operated some motor generator sets made or planned during the past year were the following: 150 kilowatts at Finspongs Metallverks, A. B., Finspong, Sweden, with furnaces for ferrous and nonferrous metal melting; 150 kilowatts at Edgar Allen Steel Works, Sheffield, England for tool steel; 150 kilowatts at Etablissement Jacob Holtzer, Unieuk, France; 150 kilowatts William Jessop & Sons, Ltd., Sheffield, England; 100 kilowatts at Kynochs, Ltd., Birmingham, England; 100 kilowatts at Hirsch, Kupfer und Messingwerke, Eberswalde, Germany for melting nickel; 60 kilowatts at American Steel Foundries, near Chicago, Ill., for laboratory purposes only; 60 kilowatts at General Electric Company, Schenectady, N. Y. for experimental work on steel melting.

The company recently had an order for a 300 kilowatt installation for a plant at Bachum, Germany.

Book Review

American Society for Testing Materials Standards, 1927, Parts I and II, cloth, 6 x 9 inches, 871 and 1000 pages respectively, published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland, for $7.50 for each part or $15 for both; in London, 416-17 Caxton House, Westminster, for 37s 6d for each part or £1 1s 6d for both.

Triennially the American Society for Testing Materials issues its book of standards which contains any revisions of old standards, and new standards adopted during the intervening years. This year the book of standards is published in two parts; Part I covering metals and Part II covering non-metallic materials. Part I contains 147 standards of which 144 are related specifically to metals and 3 are of general nature applying to both metals and non-metals.

Part II contains 196 standards covering non-metallic materials. Of these 193 are standards dealing specifically with non-metallic materials and 3 are of a general nature applying to both metals and non-metals. Each part has two indexes; one at the beginning of the book where the standards are listed according to classification of material, and the other at the back listing the standards according to subject. The latter index has the important references printed in boldfaced type.

Publishes Bulletin

A program of courses in chemical engineering and graduate courses in chemical engineering, metallurgical engineering, gas engineering and the organic chemical industries recently has been published by the University of Michigan, Ann Arbor, Mich. Copies of the bulletin may be obtained from the department of chemical engineering at the university.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Danville Iron & Steel Co., Danville, Pa., plans to build a 1-story addition.

Sellersville Foundry Co., Sellersville, Pa., plans to expand.

Central Foundry Co., Marshalltown, Iowa, recently suffered a fire loss estimated at $250,000.

Beans Foundry Co., Martins Ferry, O., recently added a steel casting department which will be placed in operation soon.

Brewton Iron Works, Brewton, Ala., has moved into its new plant and has production under way.

Delco-Remy Corp., Anderson, Ind., is inquiring for machinery and equipment for proposed foundry, 150 x 180 feet.

Quality Aluminum Casting Co., Waukesha, Wis., A. G. Harter, treasurer, plans to build a 1-story addition to its aluminum foundry.

I. B. Roswell Mfg. Co., 1310 Lincoln avenue, Waukesha, Wis., plans to build a 1-story foundry building.

Carman Iron & Bronze Works, New York, has been incorporated with 200 shares no par value stock by H. L. Kreeger, attorney.

Ford Motor Co., Detroit, has awarded the contract for structural steel for a new foundry to Dorden-Allen Co.

Roake & Sons, Oregon City, Oreg., J. A. Roake, manager, is inquiring for machinery and equipment for its contemplated 2-story foundry and machine shop, 48 x 65 feet.

Forest City-Walworth Run Foundries Co., West Twenty-seventh street, Cleveland, maker of iron castings, plans to build a 2-story office and manufacturing plant, 80 x 110 feet.

Cochrane Foundry Corp., Norristown, Pa., will move its plant from Philadelphia to Earnest Station, near Norristown where a branch plant is maintained.

Paris & Hall Foundry Co., Joliet, Ill., is building a new plant for the manufacture of gray iron, brass, bronze and aluminum castings. O. E. Paris is president.

Meadows Mfg. Co., Bloomington, Ill., maker of electrically operated washing machines, as well as operating a foundry for castings for general trade, contemplates expansion.

American Stove Co., Kingshighway and Daggett streets, St. Louis, will build an addition 88 x 117 feet to its plant at 5000 Daggett street.

American Radiator Co., has ceased operations at its Titusville, Pa. plant. Plans are being considered to manufacture other products than radiators at the plant.

Phelps Foundry Co., Ansonia, Conn., has been incorporated to deal in metals and metal articles, capital $50,000, by H. D. Phelps and others, all of Ansonia.

Quality Brass & Aluminum Foundry, Portland, Oreg., has been incorporated by Charles N. Perkins, 1076 Arnold street and Clare H. Hart, 1784 Phelps street.

Southwestern Cast Iron Pipe Co., 516 Daizell street, Shreveport, La., has made plans for a $25,000 plant including machine shop and foundry.

Fargo Foundry Co., Fargo, N. D., is building a plant addition for the manufacture of oil storage tanks and for electric welding and blacksmithing. The company is inquiring for an electric welder.

Bell-Davis Machinery Mfg. Co. Inc., Pleasant Hill, Mo., has been incorporated with $50,000 capital to manufacture castings by John F. Bell, John W. Davis and Roscoe C. Summers.

Columbia Stove Co., Metropolis, Ill., has been incorporated with $2000 capital to manufacture and deal in stoves, ranges and parts, with United States Corp. Co., 604 Carleton building, St. Louis, correspondent.

John Funk, Kimberton, Pa., has purchahsed the Madco Foundry & Machine Co., Phoenixville, Pa. The foundry building is 50 x 175 feet and there are a number of engine and boiler houses.

Oschwald Construction Co., 854 Clinton avenue, Newark, N. J., has been awarded the contract for a 3-story mechanical and woodworking shop, to be built for the Board of Education, 19 Winans street, East Orange.

Rhode Island Fittings Co., Georgia avenue, Providence, R. I., maker of pipe fittings and other iron specialties, has awarded the general contract for a 1-story addition 32 x 48 feet to E. H. Bigney, 49 Weybosset street.

Thomas Savill's Sons, 1310 Wallace street, Philadelphia, maker of plumbing equipment and supplies, will remodel a 2 and 4-story building it has acquired recently, for a new plant.

Murray Iron Works Co., Burlington, Iowa, has purchased the Standard Turbine Corp., Scio, N. Y., and is moving all the equipment to Burlington. Possible plant expansion is contemplated by the Murray company.

Automatic Gas-Steam Radiator Co., Pittsburgh, will improve recently purchased property with a brick and steel manufacturing plant. It is estimated that the improvement will cost in the neighborhood of $100,000.

Johnson Molding & Tool Co., Weymouth, Mass., has been incorporated with 250 shares no par value to manufacture machinery and tools by Elinor G. Johnson, 158 Parmenter road, West Newton, Mass.

Malleable Iron Works, New Britain, Conn., G. E. Bean, Grove and Myrtle streets, president, is inquiring for equipment including annealing and cooling conveying machinery and oven equipment, coal stoking and pulverizing machinery for proposed new hot mill being built.

Property of the Bristol Stove & Foundry Co., Bristol, Tenn., has been acquired by George McCartney & Sons Foundry Co., the new name of the company which will operate the foundry and stove works. Improvements are being made in the old plant and new machinery is being installed.

Richardson & Boynton Co., has decided to shut down indefinitely its plant at Dover, N. J. Machinery and equipment have been shipped to Bethlehem, Pa., where it is rumored that a new plant will be started. A plant of the firm at Buffalo also is closed down.

Harrison Steel Castings Co., Attica, Ind., has acquired all of the assets and real estate of the National Car Coupler Co., Attica, Ind., manufacturer of knuckles, couplers and miscellaneous steel castings. The firm will be continued with the same management and policies as formerly. J. W. Harrison is president.

Fulton-Harwood Brass Foundry Co., South Bend, Ind., operated by F. H. Fulton and L. J. Harwood, has been sold to J. Howard Ware and associates. The firm will be operated under the name of Fulton-Harwood Brass & Aluminum Co. Mr. Ware formerly was associated with a Detroit brass and aluminum foundry.

Sale of the J. L. Mott Co., Trenton, N. J., was confirmed following a hearing in the United States district court at Newark, N. J. The sale was a preliminary move in the merger of the Mott company with the Laib Co. and the Columbia Sanitary Mfg. Co., both of Louisville, Ky. as noted in the Jan. 1 issue of THE FOUNDRY.

Anniston Steel Casting Co., Anniston, Ala., has been incorporated with $50,000 capital to manufacture a variety of steel castings and parts of machinery by J. N. Hugher, president; L. O. Treadway, vice president, and A. E. Echols, secretary and treasurer. The company expects to open a new plant shortly on West Tenth street.

Trio Brass Foundry Co., Aurora, Ill., manufacturer of brass and aluminum castings, has removed to its new plant at 483 South River street. William Barbel and Otto Bergmann, who compose the firm, formerly were connected with the American Woodworking Co. The plant is equipped with a new sandblast, three new furnaces, overhead pouring track and fireproof pattern vault.

New Trade Publications

MOTOR GRINDER—Master Electric Co., Dayton, O., is issuing a bulletin describing its motor grinder, which may be used as a grinder or as a motor. It is designed for use as a fixed or portable motor in small shops needing a small power unit for operating several machines independently.

INDUSTRIAL BUILDINGS—Truscon Steel Co., Youngstown, O., has issued a bulletin on its standardized unit industrial buildings of various types for immediate erection.

INDUCTION MOTORS—Reliance Electric & Engineering Co., Cleveland, has issued a bulletin describing a new line of motors. They are fully encolsed, fan-cooled induction motors, with ball bearings. They are designed for use where the motor is exposed to much dirt, iron dust and moisture. Drawings and halftones illustrate construction.

FIRE PROTECTION—An automatic device for delivering foam to extinguish fire in inflammable liquids is described in a leaflet by the Pyrene Mfg. Co., Newark, N. J. Advantages of this method of extinguishing fire are presented and each part is fully described.

FURNACES—Heat-treating furnaces of various types, as designed by the W. S. Rockwell Co., New York, are described in a current bulletin by that company. Diagrams and halftones illustrate the text. The furnaces presented are of large size for treatment of materials loaded on cars.

GRAB BUCKETS—Various types of buckets for many kinds of digging are shown in an illustrated booklet by the G. H. Williams Co., Erie, Pa. Features of bucket construction are shown and advantages pointed out. Illustrations include views of the company's product at various tasks. Tables of specifications are presented.